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ABSTRACT

This study investigated the effectiveness of several intervention programs, in terms of increasing girls' participation in mathematics. The programs included two classes developed at Johns Hopkins University (an all-girls' accelerated mathematics class and a girls' career awareness class), and four school system-based programs based on the Study of Mathematically Precocious Youth. The populations are considered to be well-above average with respect to mathematical ability. Analysis included investigation of the impact of programs on plans to take such courses as pre-calculus, calculus, chemistry, physics, and computer science, in high school. Impact of the programs upon variables related to acceleration in mathematics was also assessed along with the rate of population attrition within the programs. The achievement of students in the school system-based accelerated classes was evaluated for possible sex differences. Questionnaire responses and the Fennema-Sherman Mathematics Attitude Scale were used to measure attitudes and interests. Comparisons were made between responses on some attitude measures and related factors such as acceleration, career goals, and life style plans. The major finding is that special programs for the mathematically gifted do have an impact on the course-taking behaviors and plans and aspirations of girls. (Author/MK)

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WOMEN AND MATHEMATICS: THE IMPACT OF EARLY INTERVENTION PROGRAMS UPON COURSE-TAKING AND ATTITUDES IN HIGH SCHOOL

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Chapter I

INTRODUCTION

In recent years, there has been a growing concern about sex differences in mathematical achievement. That concern is becoming especially acute because modern technology has made mathematical understanding essential for many of the high level careers available today. Efforts to explain the fact that fewer women than men enter mathematically related fields which focused on biological differences between the sexes have not shed light on the fact that many females who do have the aptitude and ability do not take the advanced courses (Ernest in press; Fox 1974a, b, 1976a; Haven 1972; Sells in press). Sells (in press) points out that avoidance of high school mathematics courses, not ability, is the critical filter that keeps many females from pursuing professional careers, particularly mathematically oriented ones. Comprehensive reviews of the literature on sex differences in mathematics prepared for the National Institute of Education (Fennema 1977, Fox 1977, Sherman 1977) support this as well. Girls who do not study mathematics on advanced levels are limiting their course taking options in college and thus their career options as adults.

Several social and educational explanations of the differences in course taking behavior have been postulated:

1. Girls receive less encouragement than boys from parents, teachers, guidance counselors and peers to pursue advanced mathematics courses in high school.
2. Girls are less likely than boys to perceive the usefulness of high school mathematics courses to their future goals, perhaps partly because, in adolescence, girls are not encouraged to aspire to and plan for professional careers.

3. Mathematics classes are commonly thought of as male domains and girls in adolescence may avoid them for this reason.
4. Girls have less self-confidence as learners of mathematics than boys.

Although it is serious enough that girls with average ability do not study mathematics to the same degree as do their male counterparts, what is even more alarming is that girls who are highly able in mathematics, i.e., those girls who should become high level mathematical reasoners in the future, are not taking mathematics courses at the same rate and level as are their male cohorts.

A longitudinal study was initiated in the fall of 1971, by Professor Julian C. Stanley and his project associates Lynn H. Fox and Daniel P. Keating. The Study of Mathematically Precocious Youth (SMPY) set several goals: Identification, description, and facilitation of highly able students. Through talent searches using the Scholastic Aptitude Test (SAT), which is intended for use with collegebound high school students, when administered to 7th graders, students with exceptional ability in mathematics could be discovered. Through the use of fast-paced mathematics courses in algebra, geometry, and pre-calculus, their mathematical talent could be facilitated and the student's progress accelerated at a faster rate than the regular mathematics sequence in their schools would permit. Because this was also a research study, batteries of affective and cognitive tests were given to the students identified as high mathematical reasoners in order to better understand why some children seem more able than others to develop their mathematical talent to the fullest. The initial findings of the study have been documented in two books, Mathematical Talent: Discovery, Description, and Development (1974), and Intellectual Talent: Research and Development (1976). In brief, those findings pertinent to this study are as follows:

1. Fewer females than males are eager to accelerate their progress in mathematics, and
2. Special accelerated and enriched classes in mathematics conducted by SMPY at The Johns Hopkins University were highly effective in promoting the successful study of advanced mathematics for boys but not girls in mixed-sex classes where the numbers of girls were small.

Additional studies of high ability girls in Advanced Placement Program (APP) calculus courses (Casserly in press), girls in all girl schools (Jacobs 1974), and adult women mathematicians (Helson 1971; Luchins in press) indicate that even girls with high potential in mathematics need special encouragement if their talent is to reach fruition. These girls and adults report a variety of things that made a difference for them. Those most often suggested were:

1. Access or exposure to female role models;
2. Need for a "critical mass" or ratio of males to females in a program;
3. All-girl classes in mathematics during early adolescence;
4. Early experiences in programs for the gifted;
5. The locus of control of the intervention program, i.e., whether it is a school system based program or a university or other non-school based program; and

6. Supportive attitudes of parents and teachers.

Some suggestions as to specific ways to encourage these girls include:

1. Identification and educational facilitation of girls with well-above-average ability in grades six, seven, and eight;
2. Changes in the educational policies and practices;
3. Career awareness and education at the elementary and secondary levels;
4. Career counseling at the secondary and post-secondary levels;
5. Counseling for mathematics teachers, guidance counselors and parents about the negative effects of sex-role stereotyping; and
6. Mathematics clinics and therapy to decondition mathematics anxiety.

Two classes, incorporating some of the above suggestions, were developed at The Johns Hopkins University by Dr. Lynn Fox: an all-girls accelerated mathematics class and a girls' career awareness class. In addition, a number of intervention programs designed for mathematically gifted youngsters, based on the model developed by SMPY, were instituted by various school systems. (For specific descriptions of the classes see the following section of this report.)

To date, there have been no systematic studies of the effectiveness of these different intervention strategies. The two classes at The Johns Hopkins University, along with the efforts of the several school systems, provide a naturally occurring quasi-experiment to study the impact of various strategies to facilitate mathematics course taking for females. These intervention programs, whether designed to accelerate mathematical progress for mathematically able students of both sexes, provide us with unique populations to study. By looking at the students in these programs and analyzing their achievement records, course-taking behavior and questionnaire responses, and comparing this data with similar data on control and comparison groups, some conclusions about the effectiveness of these programs in increasing girls' participation in mathematics can be reached.

The analysis included an investigation of the impact of the programs on plans to take such courses as pre-calculus, calculus, chemistry, physics and computer science in high school. The impact of the programs upon variables related to acceleration in mathematics was also assessed as well as the rate of population attrition within the programs. The achievement of the students in the school system based accelerated classes was evaluated for possible sex differences.

Questionnaire responses and the Fennema-Sherman Mathematics Attitude Scale were used to measure attitudes and interests with regard to mathematics, the impact of significant others in relation to mathematics, and plans for future careers and life styles. Comparisons were also made between responses on some of the attitude measures and related factors such as acceleration, career goals, and life style plans.

It is hoped that the analysis of attitudinal data, course-taking behavior and achievement scores will help determine the reasons why girls do or do not continue to study advanced mathematics, as well as which types of intervention programs are most effective in encouraging girls to continue course taking in mathematics.

Chapter II

DESCRIPTION OF POPULATIONS

The populations of this study are students who are considered to be well-above average with respect to mathematical ability. All but one comparison group were identified as mathematically gifted in a Talent Search* at The Johns Hopkins University as seventh graders or by their respective school system in the seventh or eighth grade. All the identification measures varied slightly from group to group. The initial screening for the majority of the groups was a score at or above the 97th percentile in the mathematical concepts subtest of the Iowa Tests of Basic Skills. Most of the students were then given a difficult test of mathematical reasoning ability such as the Scholastic Aptitude Test-Mathematics (SAT-M), or the Preliminary Scholastic Aptitude Test-Mathematics (PSAT-M), or the School and College Abilities Test-Mathematics (SCAT-M). In most instances the verbal subtests of these tests were also given. Thus, these students were those with exceptional aptitude for mathematics. One exception was that some attitudinal data was collected on a group of high school students enrolled in an all-girl private school. No cognitive test scores were collected, but the group was described by the school as an above-average ability group.

SCHOOL BASED ACCELERATED CLASSES

A model for accelerating the mathematics instruction of mathematically gifted adolescents was developed in 1972 and 1973 at The Johns Hopkins University by the Study of Mathematically Precocious Youth (SMPY). After several experimental classes had been conducted at Hopkins by SMPY, an effort was made to interest school systems in replicating the model. It was hoped that expanding the model to school systems would enable more students from a wide geographic area to participate. It was also hoped that the school systems might be more successful in attracting girls to participate in the accelerated classes than SPMY had been.

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*The study of Mathematically Precocious Youth (SPMY), at The Johns Hopkins University under the direction of Professor Julian C. Stanley have conducted 6 annual mathematics talent searches for seventh graders or young-in-grade eighth graders.

Four school system-based programs that were based on the SMPY model are included in this study. Two of the programs are sponsored by the school systems in Maryland. The other two are state supported programs in the Midwest that have selected students for the programs from major metropolitan areas within those states. A description of each of the programs follows. The number of participants in each program is shown in Table 1.

Insert Table 1

School-Based Program A.

Planning for a Mathematics Talent Search in this midwestern state began in the late spring of 1977, under the direction of the State Director of Gifted Education with the assistance of SMPY. A program was developed to include the following: first, a talent search of mathematically gifted seventh graders in the suburban area of the state's largest city; second, an awards ceremony recognizing the students identified in the talent search; and third, an accelerated fast-paced mathematics course for the highest scoring students in the talent search.

Table 1 : Number of Students Invited to Participate and Enrolled in the Special Programs

Program	Class	When class started	Number Invited			Number Enrolled		
			Boys	Girls	Total	Boys	Girls	Total
School-based Program A	I (Monday class)	Fall '77	43	12	55[1]	19	5	24
	II (Saturday class)	Fall '77				16	3	19
School-based Program B	I (7th & 8th grade class)	Fall '76	25	7	32	19	6	25
	II (9th grade class)	Fall '76	20	9	29	17	6	23
	III (7th,8th,9th gr. class)	Fall '76	*	*	*	14	3	17
	IV (1977 class)	Fall '77	21	13	34	15	13	28
School-based Program C	I	Fall '74	26	9	17	15	8	23
	II	Spr. '75	26	8	18	15	4	19
	III	Spr. '76	20	8	12	8	8	16
	IV	Spr. '77	19	*	*	6	6	12
	V	Spr. '78	23	*	*	7	6	13
School-based Program D	I	Fall '76	28	22	50	28	21	49
	Ia (Algebra I after Jan.)					11	2	13
	Ib (Algebra II after Jan.)					15	16	31
	II	Fall '77	60	42	102	31	14	45
Hopkins all-girls' accelerated class		Summer 1973	0	32	32	0	26	26
Hopkins all-girls' career awareness class		Summer 1976	0	80	80[2]	0	24	24

* Data not available

[1] Students were invited to participate in the program, not a particular class, and then chose a class based on the most convenient time.

[2] Students invited included girls from Pennsylvania, Delaware, Virginia, D.C., and throughout Maryland. Travel distance was an important factor in limiting participation, since the class was held in Baltimore.

Invitations to participate in the accelerated class were sent to the fifty-five students (43 boys and 12 girls) who scored at least 34 on the School and College Abilities Test-Mathematics (SCAT-M), and who had a combined total of at least 57 on the two portions of the SCAT, the mathematics and the verbal.

Forty-three students (35 boys and 8 girls) enrolled in the program. Two sections of the class were formed: one met on Monday evenings from 6:00 to 8:30, and the other met on Saturday mornings from 9:00 to 11:30. The students were assigned to the section of their choice based on which day they preferred. Each section had a different teacher. Both teachers were male mathematics teachers from one of the school systems included in the project, and had attended a Summer Institute at The John Hopkins University in the summer of 1977, conducted by Lynn Fox where they were able to observe a model accelerated program.

Twenty-four students (19 boys and 5 girls) were enrolled in the Monday section, and nineteen students (16 boys and 3 girls) were enrolled in the Saturday class. All of the students in the Monday class were seventh graders. The Saturday class included two eighth graders and all the rest were seventh graders.

The class began in January 1978 and completed a standard Algebra I and II curriculum by June 1978. Students who continued into the second year of the program took Plane Geometry, Trigonometry and Analytic Geometry. Upon successful completion of this phase of the program, the students were then eligible to take either Calculus or an honors pre-Calculus course at their high school.

School-Based Program B.

Accelerated mathematics classes were initiated in another midwestern state beginning with the 1976-77 school year. The project, another attempt to replicate the work of SMPY at Hopkins, was directed by the Gifted Education Coordinator for the State's Department of Education. It hoped to accelerate the mathematics learning of extremely gifted junior high school students by providing them with the opportunity to complete two years of high school algebra in a class meeting once a week for thirty weeks.

A talent search was held in the two metropolitan areas where classes were to be held. Seventh and eighth graders, as well as ninth graders who had not yet completed Algebra I, who had scored at or above the 97th percentile on an in-grade standardized test of mathematical achievement, were invited to participate in the talent search. The test selected for the talent search was the SCAT. Students were ranked first by their score on the mathematical portion of the SCAT and then, within a given range of these scores, by their verbal performance on the SCAT. In order to increase the number of girls in the classes, special consideration was given to girls when it was necessary to choose between students with equal test scores.

Three classes were formed in October 1976. Two classes, one consisting of all ninth graders and one of seventh and eighth graders, were held in one city, and a class including all three grade levels was held in the other. Thirty-two students (25 boys and 7 girls) were invited to participate in the class designated for seventh and eighth graders. Twenty-five students (19 boys and 6 girls) enrolled in this class. Twenty-nine students (20 boys and 9 girls) were invited to participate in the ninth grade class. Twenty-three of these students (17 boys and 6 girls) enrolled. Data were not available on the number invited to the class that included all three grade levels in the other city, but seventeen students (14 boys and 3 girls) enrolled in that program.

Three teachers were selected from an applicant pool of twenty-nine. One was male and the other two were female. Teaching assistants were hired to help with paper grading and other duties. The classes met for two hours one day a week during the 1976-77 school year and completed Algebra I and II.

During the 1977-78 school year, the students were given the option of continuing in the program in an Enriched Geometry and Trigonomentry class. One section of this class was held in each of the two cities. One class included fifteen students (13 boys and 2 girls) and the other included thirteen students (10 boys and 3 girls). A new section of Algebra I and II was also initiated in the fall of 1977, with twenty-eight seventh and eighth graders (15 boys and 13 girls) enrolled. The SCAT was again used for selection, and thirty-four students (21 boys and 13 girls) were invited to participate.

School-Based Program C.

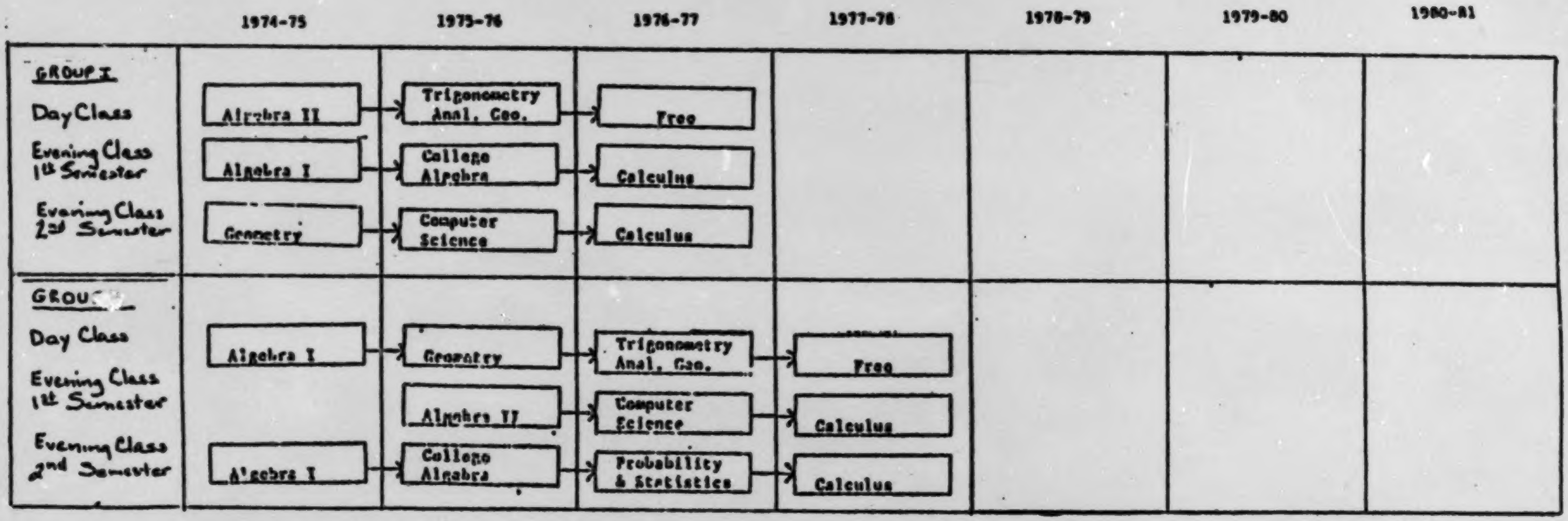
Accelerated mathematics classes, modeled after the work of SMPY, were initiated in the fall of 1974 in one of the school systems in Maryland, under the direction of the County Supervisor of Mathematics.

Students were selected for the first class that was formed on the basis of their scores on the Scholastic Aptitude Test-Mathematics (SAT-M) in the 1975 SMPY Talent Search. Twenty-six students were invited to participate; of these, twenty-three students (15 boys and 8 girls) enrolled. The class began in November 1974. The group reviewed Algebra I and then studied Plane Geometry on a once-a-week basis in the evening. The students simultaneously enrolled in Algebra II in the regular schools. The students from this group who remained in the program went on to study College Algebra and Computer Science in the evening the following year while they simultaneously took Trigonometry and Analytic Geometry during the day. In the third year of the program (1976-77), the students took Advanced Placement Calculus. Following Calculus, the students were encouraged to take additional mathematics courses at a nearby college. The sequence of courses is shown in Figure 1.

Insert Figure 1

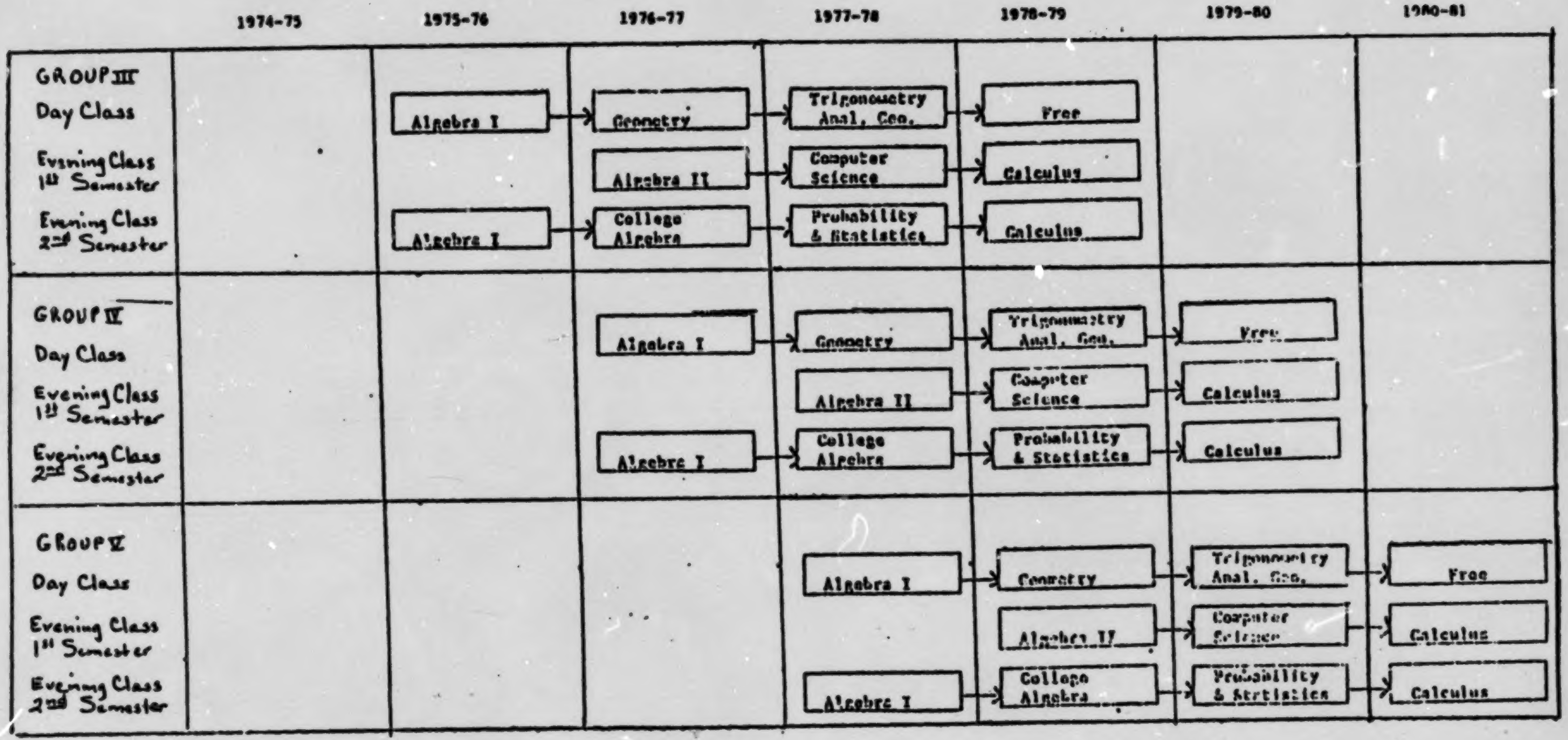
Four additional accelerated classes have been initiated in this school system since the first one. The second class began in February 1975, the third in February 1976, the fourth in February 1977, and the fifth in February 1978. These classes were no longer limited to students who had participated in SMPY's Talent Searches. Instead, it was decided that students who had scored in the upper two

Figure 1 : Flow-Chart for Sequence of Courses in the Accelerated Mathematics Program in School System C.



	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
GROUP I							
Day Class	Algebra II	Trigonometry Anal. Geo.	Free				
Evening Class 1st Semester	Algebra I	College Algebra	Calculus				
Evening Class 2nd Semester	Geometry	Computer Science	Calculus				
GROUP II							
Day Class	Algebra I	Geometry	Trigonometry Anal. Geo.	Free			
Evening Class 1st Semester		Algebra II	Computer Science	Calculus			
Evening Class 2nd Semester	Algebra I	College Algebra	Probability & Statistics	Calculus			

Figure 1 (continued)



	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
GROUP III Day Class		Algebra I	Geometry	Trigonometry Anal. Geo.	Free		
Evening Class 1st Semester			Algebra II	Computer Science	Calculus		
Evening Class 2nd Semester		Algebra I	College Algebra	Probability & Statistics	Calculus		
GROUP IV Day Class			Algebra I	Geometry	Trigonometry Anal. Geo.	Free	
Evening Class 1st Semester				Algebra II	Computer Science	Calculus	
Evening Class 2nd Semester			Algebra I	College Algebra	Probability & Statistics	Calculus	
GROUP V Day Class				Algebra I	Geometry	Trigonometry Anal. Geo.	Free
Evening Class 1st Semester					Algebra II	Computer Science	Calculus
Evening Class 2nd Semester				Algebra I	College Algebra	Probability & Statistics	Calculus

percent of their school grade on national norms on a standardized mathematics achievement test, had scored at least 125 or above on anintelligence test, and had been recommended by their guidance counselors as to their maturity, would take the Preliminary Scholastic Aptitude Test (PSAT). Scores on the PSAT determined eligibility for the program. Generally, the formula used for selection was that scores on the Mathematical portion, plus the Verbal, should total at least 80, and that the Mathematics score should be at least 40 and the Verbal at least 36.

The program for Classes II, III, IV, and V consisted of Algebra I for the first year from February until May. In the second year of the program, the students took Algebra II the first semester and College Algebra the second semester at night, and Geometry during the day in their regular school program. In the following year, they took Analytic Geometry and Trigonometry in school during the day and Computer Science and Statistics in the special class in the evening. The following year, the students took Adanced Placement Calculus. This sequence is shown in Figure 1. The number of students invited to participate and the number who actually enrolled in each of the classes are shown in Table 1.

School-Based Program D.

Accelerated classes based on the SMPY model were initiated in another Maryland school system in the fall of 1976. Students who had scored at least 130 on the Cognitive Abilities Test (CAT) and had scored at or above the 95th percentile on the mathematics portion of the Iowa Tests of Basic Skills (ITBS) were invited to

Take the Orleans-Hanna Algebra Prognosis Test. A minimum score of 40 on this test was required for admission into the program.

Forty-four seventh graders (26 boys and 18 girls) enrolled in the program. Two sections were formed, one meeting Saturday mornings and one Saturday afternoons. Students were free to attend either class. This was designed to help students avoid conflicts with sports and other activities. The class began in October. The teacher was a male who was a mathematics department chairman when the class began, and he was familiar with the SMPY model.

By January, the students had completed Algebra I and were administered a standardized Algebra I achievement test. Based on the scores on this test, the students were separated into two groups and assigned to attend one of the sections on a regular basis. One group went on to study Algebra II and completed it by June. The other group reviewed Algebra I topics for the remainder of the year. Thirty-one students (15 boys and 16 girls) completed both Algebra I and II, while eleven students (10 boys and 1 girl) completed only Algebra I.

In the fall of 1977, students who had successfully completed either Algebra I or Algebra II were given the opportunity to enroll in an accelerated Geometry class and thirty-one students (16 boys and 15 girls) enrolled. At this time, in addition, a new group of seventh graders was identified and a new accelerated Algebra I and II class was begun. In addition to the tests used the previous year, the SCAT was included in the selection process. To be included in the program, students had to meet at least four of the following criteria: a minimum score of 130 on the CAT, 95th percentile or above on the ITBS, a score of 45 or above on the Algebra Prognosis Test, a minimum score of 37 on the SCAT-M, and a minimum score of 32 on the SCAT-V.

Forty-five students (31 boys and 14 girls) enrolled in the class, as well as a third grade boy who joined the class later when he was identified by his school as ready for Algebra. Two sections were formed, both meeting on Saturday, with the students free to attend either section. Algebra I and II were taught to all of the students. There was no separation into two groups in mid-year, as there had been the year before.

In the 1978-79 school year, the students who had completed Geometry were eligible to enroll in appropriate mathematics courses in their high schools. The students who had completed Algebra I and II were eligible to enroll in the accelerated Geometry class. A new accelerated Algebra I and II class was begun, but it is not included in this study.

PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY

Students who participated in one of two programs at The Johns Hopkins University were included in the study. The first program was accelerated Algebra and the second was a career awareness class.

All-Girl Accelerated Class

An experimental all-girls' Algebra class was conducted at The Johns Hopkins University during the summer of 1973, under the direction of Lynn Fox. Thirty-two seventh grade girls who had scored 370 or above on the SAT-M (the mean score for high school junior girls) in the 1973 Talent Search conducted by SMPY and SVGY (Study of Verbally Gifted Youth), were invited to participate in the special class. Twenty-six girls enrolled in the class which was designed to complete Algebra I during the summer and to allow the girls to enroll in Algebra II in eighth grade, thus accelerating themselves one year in mathematics.

Because previous experience with accelerated classes at Hopkins had shown girls to be reluctant to enroll in such classes, this class was designed to encourage participation by meeting the social needs of girls. The class was for girls only. There were three women teachers to serve as role models. The class was taught informally, and small-group and individualized instruction were used. Cooperative rather than competitive activities were stressed. The ways in which mathematics could be used to solve social problems were mentioned whenever possible. In addition, there was a series of speakers, both men and women, who met with the girls to discuss their careers in mathematics and science.

The class met two days a week,for about two hours a day, from May through July, and covered a standard Algebra I curriculum. Following the course, those girls who had successfully completed Algebra I were encouraged to take Algebra II in their schools. The girls were followed up from 1973 through 1976, to see how the intervention affected future mathematics course-taking. (These results are reported in Section IV of this report.) Lynn Fox and her staff were available for counseling during this period when it was requested. No additional specific intervention followed the Algebra class, however.

Career Awareness Class For Girls

The top scoring girls from the 1976 SMPY Mathematics Talent Search were invited to participate in an all-girl Career Awareness class sponsored by the IGCSG (Intellectually Gifted Child Study Group) at The Johns Hopkins University in the summer of 1977. The girls invited had to have met the criterion that twice their SAT-M score plus their SAT-V score must equal at least 1330. Twenty-four end-of-the-year seventh grade girls enrolled in the class.

Class sessions were held three days a week for five weeks. In the morning sessions, the instructors and guest lecturers provided the girls with in-depth knowledge concerning their various careers or areas of interest and focused on the practical application of mathematics in solving today's human problems. The women speakers also served as role models for the girls and, it was hoped, indirectly encouraged the girls to take advanced mathematics and science courses in high school. During the afternoons, the girls were taught critical reading and study skills using articles on topics covered in the morning lectures.

During the first two weeks of the program an Associate Professor of Mathematical Sciences and Health Services Administrations at Johns Hopkins taught an integrated course on Statistics and Computers. The girls were taught a variety of topics related to probability and statistics and were shown how to use the various statistical tests already programmed into the computer. For several days, they were allowed to work independently on homework problems at computer terminals in the University Computer Center.

This was followed by a one-week course on "Our Man-Made Environment." Architectural concepts such as scale, man-made and natural environments, and the design process were taught with emphasis on problem solving through practical exercises. Various functions of architects, planners, landscape architects, and interior designers were also discussed.

A one-week course on Aging was conducted by a staff member of the National Institute of Health Gerontology Research Center. The classes were designed to provide information about aging and the elderly, to illustrate the importance of mathematics as a tool in research, and to demonstrate the logic of scientific research and analysis of research findings. The course included a field trip to the Gerontology Research Center in Baltimore.

The final week of the program was devoted to a segment entitled "Women in Science". The goals of this course were to provide role models of women in various fields of science, and to illustrate the relationship between skills these women had acquired and how they applied them in their respective careers. Eight women scientists spoke to the girls on some aspect of their jobs, such as a current project or research they were conducting. They also shared with the girls information on their educational and personal backgrounds and how these factors pertain to their current occupation or field of study.

The program was designed to make mathematically gifted girls aware of the broad spectrum of mathematically and scientifically oriented careers open to them and of how they should prepare for such occupations during their high school and college years. It was hoped in particular, that the girls would be encouraged to elect to take advanced mathematics and science courses in high school.

CONTROL AND COMPARISON GROUPS

Several groups of mathematically gifted students who had not participated in any special program were available as comparison groups. Most of these students had participated in a Talent Search as seventh graders.

Control Boys and Girls

For each experimental girl enrolled in the special accelerated class for girls conducted at Hopkins in the summer of 1973, a control girl and a control boy were selected from the remaining group of seventh graders in the 1973 Talent Search in order to measure the effects of the program. The control boys and girls were matched with the experimental girls on the basis of mathematical ability as measured by scores on the SAT-M, verbal ability as measured by scores on the SAT-V, education of mother, and education and occupation of father.

The mean SAT scores for the three groups are shown in Table 2.

Insert Table 2

Table 2: Mean SAT Scores and Educational Level of Parents of Hopkins All-Girls' Accelerated Class and Control Groups

	No.	Mean SAT-M	Mean SAT-V	Mean Educational Level* Mother	Mean Educational Level* Father
Experimental Girls	26	436	399	2.9	3.3
Control Girls	26	433	390	2.9	3.7
Control Boys	26	443	393	2.7	3.5

* Scale for educational level

1 = less than high school

2 = high school diploma

3 = some college

4 = Bachelor's degree

5 = more than Bachelor's degree

The mean score for the experimental girls was 436, for the control girls, 433, and for the control boys, 443. Although the difference between the experimental and control girls was not significant, the difference between the boys and both groups of girls was significant. The results of an analysis of variance and Tukey comparisons of the mean scores on the SAT-M are shown in the Appendix. In spite of this, the decision was made to accept the control boys as the best group available, especially since the bias was not in favor of the experimental girls.

The mean SAT-V scores were: 399 for the experimental group, 390 for the control girls, and 393 for the control boys. Analysis of variance for verbal scores for the three groups yielded no significant differences.

A summary of the educational level of the parents of the students in the three groups is also shown in Table 2. Fathers were better educated than mothers for all three groups, but there were no significant differences between groups for fathers or mothers. Fathers' occupations were also controlled for, and a Chi-square analysis of the number of fathers who were employed in occupations of an investigative nature was not signigicant.

Follow-up studies, based on questionnaires and telephone interviews, were conducted on the two control groups, along with the experimental group, between 1973 and 1976 to provide a comparison of course-taking behavior.

All-Girls' School Comparison Group

The mathematics department chairperson of a private all-girls'

School in Maryland, upon hearing of this study, offered to administer the Fennema-Sherman Mathematics Attitude Scale (F-S MAS) to the girls in her mathematics classes. The participants included 42 seventh graders, 50 ninth graders, and 38 eleventh graders.

Since the school has fairly high admission standards, the girls represent a group of above-average-ability students. They may, however, not be as motivated or as interested in mathematics as girls who would either elect to enter a mathematics talent search or choose to participate in an accelerated mathematics program. It was felt, therefore, that this group would be an important group to have for comparison purposes on the F-S MAS. The effects, if any, of being in all-female mathematics classes on the girls' attitudes toward mathematics could also be studied.

No course-taking or achievement data were collected on these girls. They were used for comparison on the F-S MAS only.

1978 Mathematics Talent Search Group

The F-S MAS was mailed to 367 high scorers from the 1978 SMPY Mathematics Talent Search. These students (all seventh or eighth graders) had scored higher than the average college-bound twelfth grades of their sex on both the verbal and mathematics sections of the SAT. For males, this is: SAT-M $\geq$ 500 and SAT-V $\geq$ 430; and for females: SAT-M $\geq$ 450 and SAT-V $\geq$ 430. Responses were received from 337 students (189 boys and 148 girls). This group serves as a comparison group of untreated highly able boys and girls against whom other populations can be compared.

Of the students who returned the F-S MAS, fifty boys and fifty girls were randomly selected and the questionnaire was mailed to them for them to complete and return. Completed questionnaires were received from forty-seven boys and forty-four girls.

Chapter III

DATA COLLECTION AND INSTRUMENTATION

DATA COLLECTION

Data were collected from school systems, schools, and individual students during the period of October 1977 through July 1979. Procedures for data collection and the actual information collected varied slightly from group to group. A brief description of data collected is provided below.

School Based Accelerated Classes

In the spring and summer of 1977 school system officials were contacted to determine their willingness to participate in the proposed research study. All four school systems initially agreed to participate. Later, some expressed reservations about the questionnaire and attitudinal measures. After the study began one or more persons in each school system acted as data collector and consultant. Information about student test scores and course-taking were provided by use of a coding system so that no names were known to the Hopkins research team. Later, attitudinal and questionnaire data were supplied in ways to enable the research team to match data but again without knowledge of student names.

As the study progressed three of the four school systems decided they did not wish to administer the Fennema-Sherman Mathematics Attitude Scales. All four administered a questionnaire designed by the research team. One school system, however, modified the questionnaire and dropped all questions except those relating to course-taking and career plans.

Two school systems also provided anecdotal information about the success of the program. This included reasons why students had dropped out of the special accelerated program.

Programs at The Johns Hopkins University

Test scores and attitudinal data were collected by the Hopkins research team directly from students who had participated in special classes at The Johns Hopkins University. Attitudinal measures were mailed to the participants and tests were administered to students on campus, in some cases prior to the initiation of the grant in 1977.

Control and Comparison Groups

The attitudinal data for the all-girl private school were collected by the school personnel. All data for the other control and comparison groups were collected from the individual students by mail questionnaire or telephone interview.

INSTRUMENTATION

Instruments used in this study include standardized tests of mathematics aptitude and achievement and measures of attitudes, course-taking plans, career goals, and evaluation of the special programs in which some students participated.

Assessment of Aptitude and Achievement

Measures of aptitude included the verbal and mathematical sections of the Scholastic Aptitude Test (SAT), the Preliminary Scholastic Aptitude Test (PSAT), and the School and College

Abilities Test (SCAT). All scores were converted to the single scale of the SAT for comparability based on conversion tables in the manual for the SCAT.

Achievement tests used in this study were those of the Cooperative Mathematics Tests for Algebra I, Algebra II, and Plane Geometry published by Educational Testing Service. Different forms of these tests were administered to different students in some groups so that all raw scores were converted to a single scaled score based on conversion tables in the manual.

Research on the standardized aptitude and achievement tests used has been extensive. Reliability, validity and normative data are available (Buros 1979).

Course-Taking and Career Plans

To supplement the data on achievement and aptitude and help explain sex differences in mathematics, students were asked about plans for future course-taking, education and careers. Items 1-4, 8 and 9 of a questionnaire (discussed in detail in the section on attitudinal measures, and shown in the Appendix) were completed by every student in the study. These questions focused on courses the students had completed and/or planned to take, their career goals, and the highest level of education they planned to complete. Course-taking data for some school system students who did not complete the questionnaire was sometimes available from the consultants.

Attitudinal Measures

Although course-taking behavior was the primary dependent variable to be studied in this project, it seemed desirable to assess possible affective impacts of participation in a special program. The initial design proposed that the Fennema-Sherman Mathematics Attitude Scales (F-S MAS) be used. Later a questionnaire was developed as an alternative attitudinal measure. A description of the F-S MAS and questionnaire follows.

Fennema-Sherman Mathematics Attitude Scale

After reviewing several measures, a decision was made to use the Fennema-Sherman Mathematics Attitude Scale (F-S MAS) as an attitude measure for this project because:

(a) it had already been used extensively, therefore, it would be possible to compare the data from this study with data from other studies;

(b) Julia Sherman planned to use the scale as part of her research project for N.I.E. and using it in this study would permit later comparisons;

(c) normative data were available on the version which was used in this study;

The F-S MAS consists of 96 Likert type items which form eight scales of 12 items each, six positive statements and six negative statements. Each response is given a score from 1 - 5, such that a five is given to the response that is hypothesized to have a positive effect on learning mathematics. Thus, strong agreement with a positively worded item and strong disagreement with a negatively worded item would both be scored as a 5. In the Mathematics as a Male Domain scale, the response indicating the least stereotyping of mathematics as masculine will receive a score of five.

The F-S MAS was administered to three groups of students: Talent Search participants, students in an accelerated school-based program (before the program), and girls of average to above-average ability in grades 7, 9, and 11 at a private girls' school. A copy of the attitude scale and a discussion of the reliability of the instrument are included in the Appendix.

The original design for the study had been to administer the F-S MAS as a measure of attitude to boys and girls who had participated in a special program (Groups II and III). Problems developed. First, two of the four school systems were negative about the idea and a third flatly refused to administer it. Second, the school system that was the most cooperative and for whom pre-class data was available had only eight girls in the program. Third, the school systems were not keeping good track of the girls who dropped out of the program. Therefore, it was not possible to compare attitudes of girls who stayed with the program with those who have not.

A decision was made, therefore, to discontinue efforts to collect F-S MAS data and concentrate on questionnaire material.

Questionnaire

It was felt that the achievement and course-taking data obtained on the subjects in the study should be supplemented with additional data on reasons why some girls continued to study mathematics and others did not. It was decided, therefore, to develop a questionnaire which would provide additional information beyond what the school systems could supply.

The questionnaire was developed in several stages. Several staff meetings were held in which the primary goals of the questionnaire and the specific information needed were discussed. Because achievement data was already available through other means, the decision was made to focus the questions on the following:

1. course-taking information, actual and intended
2. reasons for taking or not taking advanced mathematics courses
3. future educational plans
4. future career and life style plans
5. reasons to work
6. factors considered important for job selection
7. evaluative information on the special mathematics classes in which the students participated.

After the objectives had been clarified, several mathematics questionnaires that had been used in other studies were reviewed. These included:

1. Questionnaire items under consideration by the National Association for Educational Progress for use in the N.I.E. study.
2. Questionnaire items used by Project Talent in their assessment of the high school population in 1960.

3. Questionnaires developed by Maita Levine for NSF Grant #GY 11411 Project entitled Identification of Reasons Why Qualified Women Do Not Pursue Mathematical Careers.

4. Questionnaires developed by Lynn H. Fox and the Intellectually Gifted Child Study Group for use with the Hopkins' all-girls accelerated Algebra class and the Career Awareness Class for girls.

Selected questions from the above questionnaires plus those developed by the staff, related to the intial objectives were compiled and categorized and then disseminated for review and comment, after which another draft version was prepared. Copies of the tentative questionnaire and a letter soliciting comments were sent to all the recipients of the grants funded by N.I.E. on Women in Mathematics, to selected representatives of the school systems whose populations are being used for this study, and to other professionals in the area of gifted and talented, mathematics education and/or sex differences in intellectual abilities. Responses were received from twelve people, representing all the groups polled.

During this period, the questionnaire was pilot tested with a group of 18 students attending special courses sponsored by the Study of Mathematically Precocious Youth. The students who were used in the pilot testing had been already identified as highly precocious in mathematics in previous Talent Searches and therefore, were similar in age and mathematical ability to the students who were to be assessed as part of the study except that the pilot population was all male. Since the questionnaire was designed for a highly gifted population and the pilot testing was intended only to ascertain whether the questions were clear, it was believed that using an exclusively male population would not be problematic.

The students were interviewed individually after each one answered the questionnaire in order to check their responses and to ask them if they found any of the questions confusing or ambiguous. The results of this pilot testing and of the interview protocol is included in the Appendix.

After compiling the suggestions received as a result of the letter to professionals in the field and some of the problems that were noticed as a result of the pilot testing, a final form of the questionnaire was developed.

One of the Maryland school systems, upon obtaining the first form of the questionnaire, replied that they would only permit assessment of the six questions related to course-taking and career plans so an abbreviated form was written for that school system. Copies of both the longer final questionnaire and the abbreviated version are included in the Appendix.

The questionnaire was administered during the winter, 1978-9, to the students participating in programs in cooperating school systems, to the students who participated in the special Career Awareness Class at The Johns Hopkins University in the summer, 1977 and to 100 students from the 1978 Talent Search who were randomly selected from those who had completed the F-S MAS. The results of the questionnaire responses, along with the results of analysis in the areas of course-taking and achievement, are summarized in the following section.

Chapter IV

RESULTS

ANALYSIS OF COURSE-TAKING

Since the reluctance of gifted girls to take advanced mathematics courses in high school limits their college and career options later on, a major focus of this study was to investigate course-taking behavior patterns with respect to mathematics, science, and the special programs. The analysis of mathematics and science course-taking, acceleration in mathematics, and population attrition in the special programs is discussed in the following sections.

High School Mathematics and Science Courses

Since high school mathematics and science courses are prerequisites for later college and career options, the students were questioned about their course-taking plans, and group and sex differences were investigated. The students were given a list of the following courses: Algebra I, Algebra II, Plane Geometry, Solid Geometry, Trigonometry, Analytic Geometry, Elementary Functions or Pre-Calculus, Statistics, Probability Theory, Computer Science, Chemistry, Physics, and Business Math. They were asked to check one of five options describing their plans with regard to each course: "I have already taken," "I definitely plan to take", "I probably will take", "I don't know", and "I will not take".

Since very few of the students indicated a reluctance to take the introductory courses, the analysis focused on Pre-Calculus, Calculus, Chemistry, Physics and Computer Science. If students indicated plans to take Trigonometry and Analytic Geometry that was considered an acceptable pre-calculus sequence in lieu of a specific course labeled pre-Calculus. Probability and Statistics were excluded from the analysis because of their lack of availability in most high schools, and Business Math was eliminated because few students indicated an interest in it and it is not particularly relevant for this highly able population. The categories "I have already taken" and "I definitely plan to take" were combined, and the distinction between the actual and projected was presumed to be caused by age and degree of acceleration rather than a difference in degree of commitment to take the course. The responses of the students in the Hopkins Accelerated girls class and the Control boys and girls all fall into the definitely will or definitely will not categories because these students have graduated from high school and none of the responses were based on projections.

Pre-Calculus

The results of the students' responses to the question asking about their plans to take pre-Calculus are shown in Table 3. The groups with the highest percentage of students planning to take pre-Calculus in high school are the School System boys, School System girls and the Control boys. Significant differences were found in comparisons between the School System boys and the Talent Search boys ($p < .001$), between the Control boys and the Control girls ($p < .05$) and between

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Insert Table 3

Table 3 : Distribution in Percents of Students Planning to take Pre-Calculus in High School by Group and Sex

Group	Sex	N	Definitely Will	Probably Will	Don't Know	Will Not
School System	Boys	158	91.2	7.0	1.9	0 *
	Girls	68	89.7	5.9	4.4	0
Talent Search	Boys	47	70.2	14.9	14.9	0
	Girls	44	72.7**	11.4	15.9	0
Career Class	Girls	22	77.3	4.5	18.2	
Hopkins' Accel. Class	Girls	22	72.7			27.3
Control Groups	Boys	24	95.8			4.2
	Girls	24	70.8			29.2

Significant Chi-Square Comparisons

School System boys versus Talent Search boys	$\chi^2 = 16.97$	$p < .001$
Control boys versus Control girls	$\chi^2 = 5.4$	$p < .05$
Control boys versus Hopkins' Accelerated Class	$\chi^2 = 4.75$	$p < .05$

* Percents do not total 100% due to rounding.

** Four Talent Search girls indicated plans to take Calculus but not pre-Calculus. Since pre-Calculus is normally a prerequisite for Calculus, it was assumed that they will take pre-Calculus as well possibly under another name, and they are included in this percentage.

the Control boys and the Hopkins' Girls Accelerated Class ($p < .05$). A comparison of the School System girls with the Talent Search girls just missed significance at the $p \leq .05$ level.

There appears to be an effect of the special treatment so as to increase the participation of the School System boys and girls in pre-Calculus courses. The higher percentage of Control boys who took pre-Calculus as compared to the projection of the Talent Search boys may be due to the fact that the figures for the former group are actual instead of projected. The Talent Search boys who responded "probably" or "don't know" may end up taking the course.

Calculus

Table 5 shows the results of the students' responses to the question asking about their plans to take calculus in high school. The groups with the highest percentages planning to take Calculus were the School System boys and girls and the Talent Search girls. Significantly more School System boys than Talent Search boys ($p < .05$) indicated plans to take Calculus. The greater percentage of Talent Search girls than Talent Search boys reporting definite plans to take Calculus, while not statistically significant, was nonetheless surprising. On the other hand, only 4.3% of the Talent Search boys said they didn't know if they'd take it while 11.4% of the Talent Search girls reported they didn't know or would not take Calculus.

Insert Table 5

Table 4 : Distribution in Percents of Students Planning to Take Calculus in High School by Group and Sex

Group	Sex	N	Definitely Will	Probably Will	Don't Know	Will Not	
School System	Boys	156	77.6	14.7	1.3	6.4	
	Girls	68	75.0	14.7	4.4	5.9	
Talent Search	Boys	47	63.9	31.9	4.3	0.0	*
	Girls	44	72.8	15.9	9.1	2.3	*
Career Class	Girls	22	68.2	18.2	13.6	0.0	
Hopkins' Accel. Class	Girls	21	33.3			66.7	
Control Groups	Boys	22	68.2			31.8	
	Girls	20	40.0			60.0	

Significant Chi-Square Comparisons

School System boys versus Talent Search Boys	$\chi^2 = 11.24$	$p < .05$
Control boys versus Hopkins' Accelerated Class	$\chi^2 = 5.22$	$p < .05$

* Percents do not total 100% due to rounding

There were no significant differences found in a comparison between the Control boys and the Control girls, but the comparison between the Control boys and the Hopkins' Accelerated Class did reveal a significant difference in favor of the boys ($p < .05$). This is disappointing in view of expectations that the treatment class would have encouraged the girls to keep pace with if not exceed the boys in participation in mathematics courses. It appears that the brief Algebra I experience at Hopkins was not enough to maintain the girls interest through the more advanced courses without additional intervention. On the other hand, the School System programs appear to have successfully encouraged the girls in the program to participate through Calculus at the same rate as the boys. The small difference between the School System girls and the Talent Search girls, however, raises a question about the effect of treatment versus the effect of changing attitudes over time. It will be important to follow-up these groups in the future to see if the projections hold true and if those in the "probably" and "don't know" categories actually do or do not take Calculus. Perhaps gifted adolescent girls in 1978-79 are more aware of the importance of studying calculus than were their counterparts in 1973-74.

Chemistry

The percentages of students by group and sex planning to take Chemistry in high school are shown in Table 5 . There were no

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Insert Table 5

Table 5 : Distribution in Percents of Students Planning to take Chemistry in High School by Group and Sex

Group	Sex	N	Definitely Will	Probably Will	Don't Know	Will Not
School	Boys	155	78.7	12.9	5.8	2.6
System	Girls	68	82.3	7.4	10.3	0
Talent	Boys	47	66.0	17.0	12.8	4.3 *
Search	Girls	43	76.8	16.3	7.0	0 *
Career Class	Girls	22	86.4	13.6	0	0
Hopkins' Accel. Class	Girls	21	100.0			0
Control	Boys	21	95.2			4.8
Group	Girls	20	75.0			25.0

Significant Chi-Square Comparisons

None

*Percents do not total 100% due to rounding.

significant differences found in Chi Square comparisons performed between School System boys and Talent Search boys, between Career Class girls' and Talent Search girls, between Hopkins Accelerated Class girls and Control girls, or between Career Class girls and School System girls.

The highest percentages of girls planning to take Chemistry were found in the Hopkins Accelerated Class and the Career Class, neither of which had unusually high percentages planning to take either pre-Calculus or Calculus. Even though comparisons with other groups in the study were not significant, there may be some treatment effect evident with individual girls in those two Hopkins classes, both of which had Career awareness components. While these classes hoped to impact mathematical course-taking as well, their effect may have been stronger on Chemistry.

The higher percentages in both the Control boys' group and the Hopkins accelerated class compared with the younger students in the study may be at least partially a result of actual versus projected data. The students in the "probably will" and "don't know" categories may end up taking Chemistry, and, if so, the percentages would be as high as those in these two groups.

Physics

The results of the students' responses to the question asking about their plans to take physics in high school are shown in Table 6.

Insert Table 6

Table 6 : Distribution in Percents of Students Planning to take Physics in High School by Group and Sex

Group	Sex	N	Difinitely Will	Probably Will	Don't Know	Will Not	
School	Boys	156	73.1	16.7	7.7	2.6	*
System	Girls	68	72.1	17.6	8.8	1.5	
Talent	Boys	47	65.9	23.4	8.5	2.1	*
Search	Girls	44	70.5	18.2	11.4	0	
Career Class	Girls	22	59.1	31.8	9.1	0	
Hopkins' Accel. Class	Girls	21	61.9			38.1	
Control	Boys	21	90.5			9.5	
Groups	Girls	20	50.0			50.0	

Significant Chi-Square Comparisons

Control Boys versus Control Girls $\chi^2 = 8.11$ $p < .01$

Control Boys versus Hopkins' Accelerated Class $\chi^2 = 4.73$ $p < .05$

* Percents do not total 100% due to rounding

Like mathematics, physics is often viewed as a male domain, and sex differences were expected when plans to take the course were analyzed. Chi Square comparisons involving the School System, Talent Search and Career Class groups, however, revealed no significant sex or group differences. Comparisons between the Control boys and Control girls and between the Control boys and the Hopkins' Accelerated class were significant, however, at the .01 and .05 levels, respectively.

It may be that times have changed and the School System, Talent Search and Career Class students are behaving less stereotypically than did the students in the groups that are just a few years older than they are. The other possibility is that the projections will not hold up for the younger students and that the girls will not actually participate in Physics courses to the same degree as the boys do but will behave more like the Hopkins' Accelerated Class and the Control Girls while the boys will behave more like the Control boys. It will be important to observe the behavior of those who are saying "probably will" and "don't know" with respect to physics.

Computer Science

Table 7 shows the results of students' responses to the question about their plans to take Computer Science in high school.

Insert Table 7

Table 7 : Distribution in Percents of Students Planning to take Computer Science in High School by Group and Sex

Group	Sex	N	Definitely Will	Probably Will	Don't Know	Will Not	
School System	Boys	153	41.8	24.2	28.1	5.9	
	Girls	68	29.4	5.9	51.5	13.2	
Talent Search	Boys	47	42.6	27.7	25.5	4.3	*
	Girls	43	34.9	25.6	34.9	4.7	*
Career Class	Girls	22	27.2	22.7	31.8	18.2	*
Hopkins' Accel. Class	Girls	21	19.0			81.0	
Control Groups	Boys	21	28.6			71.4	
	Girls	20	20.0			80.0	

Significant Chi-Square Comparisons

School System Boys versus Girls $\chi^2 = 20.82$ $p < .001$

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* Percents do not total 100% due to rounding.

Significantly more School System boys than School System girls plan to take Computer Science in high school ($p < .001$). Comparing groups on this measure can be unfair since the course may not be available in all schools. Presumably, however, the school system boys and girls in the study have equal access to computer science courses since they're in the same school systems. The sex difference in course-taking with respect to computer science, therefore, may be an indication of differing attitudes and interests.

There were no significant differences in other group comparisons of plans to take Computer Scinece in high school.

Acceleration

Since this study hopes to identify ways to encourage mathematically able girls to take more mathematics courses, it seems valuable to identify programs that result in acceleration in mathematics. Presumably the girls who have successfully completed more difficult mathematics courses before the time when girls traditionally begin to drop out of mathematics in high school will be less likely to stop taking mathematics courses and, even if they should drop out of mathematics courses in tenth or eleventh grade, they may have completed Calculus by that time.

Bright students in most Maryland school systems normally began Algebra I in eighth grade. Less able students usually begin in the ninth grade, and some school systems in other states require all students to wait until ninth grade to begin Algebra I. Thus, students who complete Algebra I, Algebra II, and Plane Geometry by the end of ninth grade can be considered to be at least one year accelerated in mathematics. If these accelerated students continue to take a pre-Calculus course in tenth grade and Calculus in eleventh grade, they remain at least one year accelerated.

Table 8 shows the percentage of students in each group who

Insert Table 8

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completed or expect to complete Algebra I, Algebra II, and Geometry by the end of ninth grade (Variable A), those who completed or expect to complete pre-Calculus by the end of tenth grade (Variable B), and those who completed or expect to complete Calculus by the end of eleventh grade (Variable C).[1]

Table 9 shows a list of hypotheses relative to mathematics

Insert Table 9

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course-taking and acceleration and the results of Chi-Square comparisons generated by these hypotheses. A key explaining the groups and variables is shown on page 59 . For the purposes of this analysis, the number of students known to have taken certain courses and those planning to take them were combined so that all students were classified as either yes or no with respect to the variables being tested. The percentages

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[1] This data was based on questionnaire responses.

Table 8

Distribution, in Percents, of Students Who Completed Algebra I, II and Geometry by the End of the 9th Grade (Variable A), Pre-Calculus by the End of 10th Grade (Variable B), and Calculus by the End of 11th Grade (Variable C), and Were, Thus, at Least One Year Accelerated in Mathematics

Group	Variable A					Variable B					Variable C				
	N	yes	proj. yes	no	proj. no	N	yes	proj. yes	no	proj. no	N	yes	proj. yes	no	proj. no
1. Career Awareness Class	22	36.4	0.0	63.6	0.0	22	9.1	22.7	0.0	68.2	22	0.0	31.8	0.0	68.2
2. Hopkins All-Girls' Accel. Class	26	46.2	0.0	53.8	0.0	26	46.2	0.0	53.8	0.0	26	19.2	0.0	80.7	0.0
3. School System Girls[1]	64	79.7	1.6	10.9	7.8	64	40.6	34.4	6.3	18.8*	64	3.1	60.9	6.3	29.7
4. School System Boys[1]	148	81.1	5.4	12.2	1.4*	148	35.8	48.0	8.8	7.4	148	9.5	68.2	8.1	14.2
5. Control Girls	25	12.0	0.0	88.0	0.0	23	8.7	0.0	91.3	0.0	23	8.7	0.0	91.3	0.0
6. Control Boys	26	19.2	0.0	80.8	0.0	26	30.8	0.0	69.2	0.0	26	34.6	0.0	65.3	0.0
7. Talent Search Girls	44	9.1	31.8	9.1	50.0	44	4.5	36.4	0.0	59.1	44	2.3	38.6	0.0	59.1
8. Talent Search Boys	47	34.0	25.5	4.3	36.2	47	12.8	44.7	0.0	42.6*	47	4.3	53.2	0.0	42.6 *

[1] Excludes one school system class where all students began as ninth graders, since this program did not provide Algebra I, II and Geometry in that one year.

* Does not total 100 percent due to rounding.

Table 9 : Results of Chi Square Tests of Hypotheses relative to the impact of different treatments upon mathematics course-taking

Hypothesis	Group[1]	Variable[1]		Level of Significance
I. Boys and girls differ with respect to mathematics courses taken in high school	V vs. VI	A	.5	n.s.
		B	3.66	n.s.
		C	4.7	$p < .05$
	VII vs. VIII	A	2.46	n.s.
		B	1.87	n.s.
		C	1.87	n.s.
II. Girls who participate in an accelerated program will differ from girls who were not in a special program with respect to mathematics courses taken in high school.	II vs. V	A	7.16	$p < .01$
		B	8.39	$p < .01$
		C	1.1	n.s.
	III vs. V	A	36.5	$p < .001$
		B	30.43	$p < .001$
		C	20.75	$p < .001$
	II vs. VII	A	.08	n.s.
		B	.08	n.s.
		C	3.48	n.s.
	III vs. VII	A	16.88	$p < .001$
		B	11.36	$p < .001$
		C	4.74	$p < .05$
III. Girls who participated in an accelerated mathematics program will differ from boys who were not in an accelerated program with respect to course taking in high school.	II vs. VI	A	4.28	$p < .05$
		B	1.3	n.s.
		C	1.56	n.s.
	III vs. VI	A	30.62	$p < .001$
		B	15.39	$p < .001$
		C	6.49	$p < .05$
	II vs. VIII	A	1.21	n.s.
		B	.86	n.s.
		C	9.93	$p < .01$
	III vs. VIII	A	6.33	$p < .05$
		B	3.81	n.s.
		C	.50	n.s.
IV. Girls and boys who participate in accelerated mathematics classes will not differ with respect to mathematics courses taken in high school.	III vs. IV	A	.59	n.s.
		B	1.71	n.s.
		C	3.60	n.s.

[1] The variables and groups are defined in the key on page 59 of this report.

Table 9 (continued)

	Hypothesis	Group[1]	Variable[1]		Level of Significance
V.	Girls who participated in a school system based accelerated program will differ from girls who participated in a special summer accelerated program with respect to course taking in high school.	II vs. III	A	11.09	$p < .001$
			B	6.92	$p < .01$
			C	14.87	$p < .001$
VI.	Girls who participated in a career awareness program will not differ from girls who had no program with respect to course taking in high school.	I vs. V	A	3.87	$p < .05$
			B	3.76	n.s.
			C	3.76	n.s.
		I vs. VII	A	.008	n.s.
			B	.20	n.s.
			C	.20	n.s.
VII.	Girls who participated in an accelerated class will differ from girls in a career awareness class with respect to course taking in high school.	I vs. III	A	13.58	$p < .001$
			B	11.44	$p < .001$
			C	5.66	$p < .05$
		I vs. II	A	.47	n.s.
			B	1.02	n.s.
			C	1.01	n.s.
VIII.	There is no difference between mathematically gifted girls who were seventh graders in 1973 and were not in a special program, and those who were seventh graders in 1978 and were not in a special program with respect to mathematics course taking in high school.	V vs. VII	A	6.29	$p < .05$
			B	7.49	$p < .01$
			C	7.49	$p < .01$
IX.	There is no difference between mathematically gifted boys who were seventh graders in 1973 and were not in a special program, and those who were seventh graders in 1978 and were not in a special program with respect to mathematics course taking in high school.	VI vs. VIII	A	11.0	$p < .001$
			B	4.77	$p < .05$
			C	3.49	n.s.

KEY

Dependent Variables

A. Number and percentage of students completing Algebra I, Algebra II, and Plane Geometry by or before the end of the ninth grade (at least one year ahead of schedule).

B. Number and percentage of students completing all pre-requisite courses for the Calculus by or before the end of the tenth grade.

C. Number and percentage of students who completed Calculus by or before the end of the eleventh grade.

Groups

I. Girls in a Career Awareness program in the summer after seventh grade in 1977.

II. Girls in an accelerated mathematics class at The Johns Hopkins University in the summer after the seventh grade in 1973.

III. Girls in accelerated mathematics programs conducted by four school systems in the years 1974-75, 1975-76, 1976-77, and 1977-78 when the girls were seventh graders.

IV. The boys who participated in special accelerated mathematics classes in four school systems in the years 1974-75, 1975-76, 1976-77, and 1977-78 when the boys were seventh graders.

V. A group of girls who were not in an accelerated program who were seventh graders in 1973 and matched with Group II on measures of ability and socio-economic variables.

VI. A group of boys who were not in an accelerated mathematics program who were seventh graders in 1973 and matched with Groups II and V on measures of ability and socio-economic variables.

VII. Girls who participated in the 1978 Talent Search and were not in an accelerated program.

VIII. Boys who participated in the 1978 Talent Search and were not in an accelerated program.

of students in each group with regard to Variables A, B, and C condensed into the two categories of yes or no are shown in Table 10.

Insert Table 10

Hypothesis I

The first hypothesis states that boys and girls differ with respect to mathematics courses taken in high school. To test this hypothesis, the boys and girls in the untreated groups were compared on Variables A, B, and C. A comparison of the two control groups from 1973 revealed no significant differences at the end of ninth or tenth grade, but there was a significant difference ($p < .05$) in the eleventh grade with more boys than girls taking Calculus. Without being in a special program the boys were more willing than the girls to accelerate in mathematics and to take Calculus in eleventh grade. This supports the hypothesis.

This hypothesis does not hold true, however, for the comparison between the 1978 Talent Search boys and girls. There were no significant differences between the Talent Search boys and girls on any of the three variables. Students' willingness to accelerate in mathematics appears to have increased in the interim for both boys and girls, but particularly for girls. There are two possible explanations for this. One is that things have really changed since

Table 10 : Distribution in Percents of Students who completed Algebra I, II, and Geometry by the end of 9th grade (Variable A), Pre-Calculus by the end of 10th grade (Variable B), and Calculus by the end of 11th grade (Variable C) consolidated so that actual and projected course-taking are combined into the categories of "yes" and "no" with respect to each variable.

	Variable A			Variable B			Variable C		
Group	N	% Yes	% No	N	% Yes	% No	N	% Yes	% No
I. Career Class	22	36.4	63.6	22	31.8	68.2	22	31.8	68.2
II. Hopkins' Accel. Class	26	46.2	53.8	26	46.2	53.8	26	19.2	80.7*
III. School System Girls	64	81.3	18.7	64	75.0	25.1*	64	64.0	36.0
IV. School System Boys	148	86.5	13.6*	148	83.8	16.2	148	77.7	22.3
V. Control Girls	25	12.0	88.0	23	8.7	91.3	23	8.7	91.3
VI. Control Boys	26	19.2	80.8	26	30.8	69.2	26	34.6	65.3*
VII. Talent Search Girls	44	40.9	59.1	44	40.9	59.1	44	40.9	59.1
VIII. Talent Search Boys	47	59.5	40.5	47	57.5	42.6*	47	57.5	42.6

1973 and there is an increased awareness of the relevance of mathematics courses to college and career goals and of women's expanded options for careers outside the home. Another possibility is that the girls' projections of their future behavior are not correct. The 1973 group is now in college and the figures for them are based on actual courses taken. The 1978 group is only in the ninth grade, so projections were made based on what mathematics courses the students are currently taking and their planned courses for the next two years. They may or may not actually take the courses later. If the girls' projections are less accurate than those of the boys, a sex difference in course-taking will result. It is, however, encouraging that the ninth grade girls in this study are at least aspiring to take the advanced mathematics courses and indicate a willingness to accelerate their study of mathematics.

Hypothesis II

The second hypothesis states that girls who participate in an accelerated mathematics program will differ from girls who were not in a special program with respect to mathematics courses in high school. To test this hypothesis, the girls in the two accelerated programs (The School System classes and the 1973 Hopkins all-girls class) were compared with the girls in the two untreated groups.

A comparison of the 1973 Hopkins class with the control girls revealed significant differences on Variables A and B, but not on C. This was largely a result of the fact that six girls from the accelerated class who had completed all their pre-Calculus requirements by the end of tenth grade took College Algebra instead of Calculus in eleventh grade. Although their reluctance to take Calculus contrasts with the behavior of the comparison group of boys, the girls are basically still more accelerated than the control girls. A comparison between this class and the 1978 Talent Search girls, however, yielded no significant differences on any of the three variables. In fact, the percentage of girls who are accelerated (or projected to be accelerated) is slightly higher for the Talent Search groups than it is for the 1973 Hopkins class.

The School System accelerated girls were also compared with the two untreated groups and there were significant differences favoring the School System girls in both comparisons on all variables. Thus, even though the Talent Search girls have shown a willingness to accelerate, they are not accelerated to the same degree as the girls in the School System accelerated classes.

The hypothesis holds true, therefore, for comparisons involving the girls who participated in the School System accelerated classes, but the girls in the 1973 Hopkins class did not accelerate at a faster rate than the 1978 Talent Search girls. Again, it is not clear whether this is a result of a change in attitude during the time interval involved or whether it is the difference between projected and actual course-taking.

Hypothesis III

The third hypothesis states that girls who participated in an accelerated mathematics program will differ from boys who were not in an accelerated program with respect to course-taking in high school.

To test this hypothesis, the two groups of accelerated girls (School System and 1973 Hopkins class) were compared with the two groups of untreated boys.

A comparison between the 1973 Hopkins' accelerated class and the Control boys revealed a significant difference at the end of the ninth grade. A comparison of this class with the 1978 Talent Search boys revealed no significant differences on Variables A and B, but there was a significant difference in favor of the boys ($p < .01$) on Variable C. It appears that this class did not serve to accelerate the girls at a faster rate than the boys accelerate without intervention. It did, however, help the girls keep pace with the boys. The difference favoring the boys on Variable C may again be due to the reluctance of girls to take Calculus.

A comparison between the School System accelerated girls and the Control boys revealed significant differences at all levels in favor of the girls. A comparison between the School System accelerated girls and the Talent Search boys revealed a significant difference on Variable A, but not on B and C. The accelerated girls do not, therefore, remain more accelerated than the untreated boys, but the class appears to have helped them keep pace with the boys.

Hypothesis IV

The fourth hypothesis states that girls and boys who participate in accelerated mathematics classes will not differ with respect to mathematics courses taken in high school. A comparison of the boys and girls in the School System accelerated classes revealed no significant differences on the three variables, thus supporting the hypothesis.

Hypothesis V

The fifth hypothesis states that girls who participated in a school system based accelerated program will differ from girls who participated in a special summer accelerated program with respect to course-taking in high school. A comparison of the 1973 Hopkins' girls revealed significant differences on Variables A, B, and C with the School System girls showing greater acceleration. The hypothesis is thus supported.

There are several reasons for this difference. One is that the school system programs are usually more accelerative than that particular Hopkins class was which only accelerated the girls one year in mathematics in a summer. Even more important, however, is that there is a greater willingness on the part of School System personnel and possibly also the girls themselves to continue acceleration in mathematics after the program ends when it is a school based program than when the program is held elsewhere. The time interval between 1973 when the Hopkins' class was held and the initiation of the School System programs between 1974 and 1977 may also be a factor.

Hypothesis VI

The sixth hypothesis states that the girls who participated in a Career Awareness program will not differ from girls who had no program with respect to course-taking in high school. A comparison between the Career Class girls and the Control girls revealed a significant difference favoring the Career Class girls on Variable A, but none on Variables B and C. There were no significant differences in comparisons between the Career Class girls and the Talent Search girls.

The hypothesis, therefore, appears to be supported.

Hypothesis VII

This hypothesis states that girls who participated in an accelerated class will differ from girls in a Career Awareness class with respect to course-taking in high school. A comparison between the Career Class girls and the School System accelerated girls revealed significant differences in acceleration favoring the School System girls at all three grade levels, thus supporting the hypothesis. The hypothesis does not hold true, however, in a comparison of the 1973 Hopkins' class with the Career Class. There were no significant differences between these two groups.

Hyposthesis VIII

The eighth hypothesis is intended to compare the two untreated groups of girls in the study with respect to acceleration: the Control girls and the Talent Search girls. It states that there is no difference between mathematically gifted girls who were seventh graders in 1973 and were not in a special program, and those who were seventh graders in 1978 and were not in a special program with respect to mathematics course-taking in high school. Consistent differences between the two groups at all three grade levels were revealed, thus refuting the hypothesis. As was mentioned earlier, it was not clear whether these differences are due to changes in course-taking behavior between 1973 and 1978, or whether the differences were based on projections that may not hold true.

Hypothesis IX

This hypothesis is the same as the eighth, but for the two groups of untreated boys. It states that there is no difference between mathematically gifted boys who were seventh graders in 1973 and were not in a special program, and those who were seventh graders in 1978 and were not in a special program with respect to mathematics course-taking in high school. There was a significant difference between the two groups on Variables A and B favoring the 1978 Talent Search group, but these differences apparently disappeared by eleventh grade, because there was no significant difference on Variable C. The 1978 group accelerated at a younger age, but both groups appeared willing to accelerate.

Population Attrition in the Accelerated Classes

In order for the special accelerated mathematics classes to succeed in accelerating students in mathematics and to encourage increased participation in advanced courses, it was important that the students remain in the special programs and not drop out. This study, therefore, investigated the rate of population attrition in the accelerated classes and sought to determine if the programs were equally successful in keeping girls enrolled as they were in keeping boys enrolled.

School-based Program A

Table 11 shows the number and percent of students in School-based Program A who completed two years in the accelerated program. The 43 students enrolled were divided into two classes, one of 24 and one of 19, the first year. The students who continued the second year were combined into one class. After completing the two years, the students were eligible to enroll in either a pre-Calculus or a Calculus course (depending on achievement level) in high school.

Insert Table 11

There were relatively few girls enrolled in this program: eight as compared with 35 boys. Of these eight girls, three were in one class during the 1st year and five were in the other so the number of girls in each class was quite small. Of those who started in the program, however, 62.5% of the girls and 57.1% of the boys completed the two years. The girls did not drop out of the program at a higher rate than the boys and the three girls who composed the entire female population of one of the sections all completed the program.

School-based Program B

The number and percent of students in School-based Program B who completed the two year special mathematics program are shown in Table 12. These students upon completion of the program, were also eligible to enroll in an advanced mathematics course in high school. This state-sponsored program included three classes initiated in 1976 and one in 1977.

Insert Table 12

Of the three classes initiated the first year, two were held in one city (one class for 7th and 8th graders and one class for 9th graders), and the other class, for all three grade levels, was held in another city. The class held in the city where only one class was formed reported a higher completion rate for both boys and girls (70.6%) than the classes in the other city (32% and 30.4%) and all three of the girls in the class completed the program.

Table 11 : Number and Percent of Students in School-based Program A Who Completed Two Years in the Accelerated Mathematics Program and Number who dropped out.

	Boys	Girls	Total
Number enrolled in 1st year of program	35	8	43[1]
Number dropped during 1st year	6	2	8
Number who completed 1st year but did not complete 2nd year of program	9	1	10[2]
Number who successfully completed both years of the program	20	5	25
Percent who successfully completed both years of the program	57.1%	62.5%	58.1%

[1] five additional students (1 girl and 4 boys) enrolled but dropped out so early that they were not included in any of the information about the class provided by the school system.

[2] five of these students (1 girl and 4 boys) enrolled in high school full time the second year of the program and presumably were able to get an appropriate mathematics course there.

Table 12 : Number and Percent of Students in School-based Program B Who completed Two Years in the Accelerated Mathematics Program

	1976 7th & 8th grade class			1976 9th grade class			1976 7th, 8th & 9th grade class			1977 class		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Number Enrolled 1st year of program	19	6	25	17	6	23	14	3	17	15	13	28
Number dropped during 1st year	1	0	1	0	0	0	0	0	0	0	3	3
Number who completed 1st year but did not complete 2nd year of program	11	5	16	11	5	16	5	0	5	2	8	10
Number who successfully completed both years of the program	7	1	8	6	1	7	9	3	12	13	2	15
Percent who successfully completed both years of the program	36.8%	16.7%	32%	35.3%	16.7%	30.4%	64.3%	100%	70.6%	86.7%	15.4%	53.6%

The class formed in 1977 was held in the city where the two had been the year before and, for the first time, the ratio of boys to girls was almost even with 15 boys and 13 girls in the class. The percentage of boys completing this class was high (86.7%) but for girls it was very low (15.4%) with most of the girls electing not to participate in the second year of the program.

School-based Program C

The program in School System C was somewhat different from that in the other school systems in that it was longer than two years and took the students through Calculus, and the students simultaneously took one course during the day in school and another at night in the special program. A more detailed description of the program is included in Chapter II of this report.

Table 13 shows the number of students who completed each course in the sequence while still enrolled in the special program. The percentage of students who stayed in the program through Algebra I, Algebra II and Geometry was computed for comparison purposes and is shown on the table. Completion rates through geometry were as follows: Class I, 91.3% (93.3% of the boys and 87.5% of the girls); Class II, 68.4% (73.3% of the boys and 50% of the girls); Class III, 62.5% (62.5% of both boys and girls); Class IV, 58.3% (50.0% of the boys and 66.7% of the girls; and Class V, 69.2% (85.7% of the boys and 50% of the girls). The first class was the most successful in keeping both

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Insert Table 13

Table 13: Number of Students Who Completed Each Course and Number Who Dropped out of the Accelerated Mathematics Program in School-based Program C.

				Number of Students Who Remained in Program Through Each Course																													
Class	Number Enrolled			Alg. I			Alg. II			Geom.			Trig.			Analyt. Geom.			College Alg.			Computer Science			Calculus			Dropped Program			% who completed Alg. I, II & Geom.		
	B	G	T	B	G	T	B	G	T	B	G	T	B	G	T	B	G	T	B	G	T	B	G	T	B	G	T	B	G	T	B	G	T
I	15	8	23	15	8	23	14	7	21	15	7	22	14	8	20	12	8	20	13	7	20	13	7	20	6	3	9	9	5	14	93.3%	87.5%	91.3%
II	15	4	19	15	4	19	11	2	13	11	4	15	7	2	9	5	2	7	10	2	12	5	0	5	0[1]	0[1]	0[1]	10	4	14	73.3%	50.8%	68.4%
III	8	8	16	8	8	16	7	7	14	5	5	10	4	4	8	3	4	7	5	5	10	5	3	8				3	3[2]	6	62.5%	62.5%	62.5%
IV	6	6	12	6	6	12	3	4	7	3	4	7																3	2	5	50.0%	66.7%	58.3%
V	7	6	13	7	6	13	6	3	9	6	3	9																1	3	4	85.7%	50.0%	69.2%

[1] This group did not take Calculus

[2] Although five girls did not take Computer Science, only three are listed by the county as having dropped the program. Presumably the other two girls plan to take Calculus.

Key: B = Boys
G = Girls
T = Total

boys and girls enrolled at least through geometry, and the last class retained a high percentage of the boys. Class II which had the smallest proportion of girls compared to boys (4 vs. 15) lost 50% of its girls by the end of Algebra II and none of the girls continued into Computer Science.

School-based Program D

Table 14 shows the number and percent of students in School-based program D who completed two years in the accelerated mathematics program. These students were then eligible to enroll in a pre-Calculus level course in high school.

Insert Table 14

This school system had a fairly high number of girls enrolled in the program with 18 girls in the class that began in 1976 and 14 girls in the class that began in 1977. The first class was more successful than the second at keeping girls enrolled. 77.8% of the girls in the first class completed the two years while only 57.1% of the second class did. A higher percentage of boys completed the second class (80.6%) than did the first class (65.4%).

Attrition in the School-based Programs

Previous experience with accelerated classes at the Johns Hopkins University in mixed sex classes where girls were greatly outnumbered by boys and the drop-out rate among the girls was high had led the

Table 14 : Number and Percent of Students in School-based Program D Who Completed Two Years in the Accelerated Mathematics Program and Number Who Dropped Out.

	1976 - 77 Class			1977 - 78 Class		
	Boys	Girls	Total	Boys	Girls	Total
Number enrolled in 1st year of program	26	18	44	31	14	45
Number dropped during 1st year	1	1	2[1]	3[5]	4[6]	7[4]
Number who completed 1st year but did not complete 2nd year of program	8[2]	3[3]	11	3[7]	2	5
Number who successfully completed both years of the program	17	14	31	25	8	33
Percent who successfully completed both years of the program	65.4%	77.8%	70.5%	80.6%	57.1%	73.3%

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[1] At mid-year the class was divided so that students who were not doing as well as desirable repeated algebra I while the rest of the class continued into Algebra II. These students are not counted as dropping out because they remained in the Special program and were eligible for Geometry the following year. Ten boys and one girl were in this category.

[2] One of these boys skipped 8th grade and took Geometry in high school and two moved out-of-state

[3] Two of these girls skipped 8th grade and took Geometry in high school and the other one moved out-of-state

[4] Two additional girls and one additional boy dropped during the 1st year to complete Algebra I in their school but rejoined the Special class for Geometry and thus are not included with the drop-outs.

[5] One boy moved out-of-state

[6] One girl moved out-of-state

[7] One boy skipped 8th grade and took Geometry in high school and one moved out-of-state

investigators in this study to suspect that there may be a need for a "critical mass" or minimum number of girls in a mixed sex accelerated class to encourage girls to stay in the program and not view the class as a male domain. The results of this study do not necessarily, support this.

In School System A where female enrollment in the accelerated program was low, the attrition rate for girls was also low. In School System B, the class with the smallest number of girls (3) lost none to attrition, while the class with 13 girls lost 11. On the other hand, the other two School System B classes with relatively small numbers of girls had high attrition rates. School System C showed no pattern either. The class with the smallest proportion of girls (Class II) had lost half of them by the time the group completed Geometry but so did a class where almost half the class was female (Class V). The classes in School System D, which began with relatively large numbers of girls, were fairly successful in minimizing attrition among the girls, but not noticeably better than some of the classes in the other systems that had fewer girls.

No clear pattern emerges from this, therefore. One interesting phenomenon, however, is the fact that the only two classes that lost no girls to attrition were the ones in School Systems A and B that began with only three girls. In some cases the need for a critical mass may be a factor in preventing attrition. It is possible, however, that when the number of females is very small (as in the classes with only three girls) the girls form a cohesive group and none drop out so as not to desert the others.

The school systems were encouraged to provide any information they had on reasons for attrition. This was not available in most cases. School system A provided fairly complete information on why individual students dropped out and School System D provided information on some of the students.

Of the students who dropped out of the program in School System A, almost all of the reasons were related to either an unwillingness to do the homework or the course being too difficult. One girl was affected by her friend dropping out and she eventually did too. The comment about her by her teacher was:

> "Very frustrated even though she did well in the course. Crying because of homework. Her best friend also dropped out."

School System D provided information on students who left the program to enroll in high school or because their families moved out of state, and these students are footnoted in Table 14. The other dropouts left the program to return to a lower level less accelerated mathematics course in their regular school. While the reasons were not provided by the school system, it seems likely that the reasons must have been similar to those given by the students in School System A: too much homework or the course was too difficult.

Other Treatment Programs: The Hopkins' Girls' Classes

Table 15 shows the number and percent of girls who completed the Hopkins' All-Girls' Accelerated Class and the Career Awareness Class. The percentage of students who completed the Accelerated Class was 69%

but all of the girls who enrolled in the Career Awareness class completed it.

Insert Table 15

Table 15: Number and Percent of Students in Hopkins-based All-Girls Classes Who Completed Program

Class	Number Enrolled	Number Completed	Number Dropped	Percent Completed Course
Accelerated Class	26	18	8	69
Career Awareness Class	24	24	0	100

ACHIEVEMENT IN SPECIAL PROGRAMS

A question of concern in this study was whether or not boys and girls who participated in accelerated mathematics programs differed with respect to achievement as measured by standardized tests. The achievement tests used were the Algebra I, Algebra II, and Plane Geometry tests of the Cooperative Mathematics Test Series published by the Educational Testing Service.

Students in most of the programs were administered tests of mathematical and verbal aptitude for selection into the program. Students were given either the Scholastic Aptitude Test (SAT), the Preliminary Scholastic Aptitude Test (PSAT), or the School College and Abilities Test (SCAT). Using conversion tables provided in the manuals for the SCAT it was possible to convert all scores to the SAT scale for comparisons. Mean SAT-M and SAT-V scores or equivalent scores from the PSAT or SCAT are shown in Table 16 along with the achievement test scores. The boys scored slightly higher on SAT-M and slightly lower on SAT-V than the girls. There was, however, no significant difference on achievement measures. Indeed the levels of performance for both boys and girls were extremely high on all three tests. In Algebra I the mean converted score of 168 for both sexes is at the 97th percentile for 8th graders

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Insert Table 16

Table 16

Means and Standard Deviations on Aptitude and Achievement Tests for Students in School System Accelerated Mathematics Programs, by Sex

Test	Sex	Number	$\overline{X}$	s.d.
SAT-M	Girls	73	518	77
	Boys	185	556	91
SAT-V	Girls	65	436	92
	Boys	171	405	89
Algebra I	Girls	87	168	6
	Boys	208	168	6
Algebra II	Girls	65	164	7
	Boys	166	166	7
Geometry	Girls	41	168	8
	Boys	114	171	8

on national norms and the girls' and boys average scores were at the 93rd and 95th percentile, respectively, for Algebra II, on national norms. The girls average score was at the 97th percentile and the boys average score was at the 98th percentile on the test of Plane Geometry knowledge. The number of cases varies for each test due to attrition of students during the course of the program.

Analysis of covariance for achievement of boys and girls on the tests of Algebra I, Algebra II and Plane Geometry were performed using mathematical aptitude as measured by the SAT-M or equivalent converted PSAT or SCAT. There were no significant sex differences in these analyses as shown in Table 17. These analyses included only those cases for whom both aptitude and achievement test scores were available.

Insert Table 17

Since the students selected for the programs had been carefully chosen on the basis of ability, it seemed likely that interest rather than ability would determine success in the programs. Mathematical aptitude as measured by the SAT-M or its equivalent did not appear to be significantly related to completion of the programs. The mean SAT-M scores of students who completed the programs and those who did not are shown in Table 18.

Insert Table 18

Table 17 : Analysis of Covariance of Achievement Scores on Tests of Algebra I, Algebra II and Plane Geometry for Girls and Boys in Accelerated Mathematics Controlling for Aptitude

	Scources of Variation	df	SS	MS	F
Algebra I	Covariate: SAT-M	1	2279.394	2279.394	99.891
	Sex	1	79.034	79.034	3.464
	Within	246	5613.451	22.819	
Albegra II	Covariate: SAT-M	1	2351.419	2351.419	74.758
	Sex	1	42.789	42.789	1.360
	Within	196	6164.897	31.454	
Plane Geometry	Covariate: SAT-M	1	895.600	895.600	14.821
	Sex	1	74.112	74.112	1.226
	Within	120	7251.476	60.429	

Table 18 : Number and Mean SAT-M Score or Equivalent of Students* who Completed or Dropped from the Special Accelerated Classes, by Sex and School System

		Completed		Dropped	
School System	Sex	Number	Mean SAT-M	Number	Mean SAT-M
A	Boys	20	506	15	487
	Girls	5	462	3	453
B **	Boys	32	627	18	646
	Girls	6	610	14	614
C	Boys	38	484	9	441
	Girls	23	480	8	459
D	Boys	25	544	6	518
	Girls	8	510	6	518

* The cases included in this table are those for whom SAT-M scores were available

** Excludes Class where all students enrolled were 9th graders because they were older when aptitude measure was taken.

In school system A the average SAT-M scores of boys and girls who did not complete the program were slightly lower than the average scores of the boys and girls who completed the program. There did not, however, appear to be a direct relationship between scores on the SAT-M and course-completion. The boys and girls with the lowest SAT-M scores of the group both completed the program. The two highest scoring boys and the two highest scoring girls completed the program. The dropouts were chiefly among the middle range of scores.

In school system B the average SAT-M scores for boys and girls who did not complete the program were slightly higher than the average scores of the boys and girls who completed the program. One of the two highest scoring boys and the highest scoring girl did not complete the program. The four lowest scoring boys and one of the three lowest scoring girls completed the program.

In school system C the mean SAT-M scores of those students who did not complete the program were slightly lower than the mean scores of those who did finish the program. The two boys with the lowest SAT-M scores did not complete the program but the two lowest scoring girls did finish.

In school system D the boys who did not complete the program scored on the average slightly lower on the SAT-M than boys who did finish but this was not true of the girls. The two lowest scoring girls completed the program.

With the exception of school system B, boys and girls who did not complete the programs tended to fall in the middle range of ability of their classes rather than at either extreme. Even in system B the majority of dropouts scored in the middle ranges of the

SAT-M. Thus, ability as measured by the SAT-M was not the crucial factor for successful completion of the program.

Pearson product - moment correlation cooefficient were computed between and among the aptitude (SAT-M and SAT-V) and achievement measures (Algebra I, Algebra II and Plane Geometry) and are shown in Table 19 . For both boys and girls there was a significant

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Insert Table 19

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correlation between SAT-M and SAT-V. SAT-M scores were significantly correlated with scores on the Algebra I and the Algebra II tests for both boys and girls but the correlation between SAT-M scores and the Geometry test scores was significant for boys but not girls. Scores on SAT-V were not correlated with achievement test scores in Algebra I, Algebra II or Geometry for either sex. Algebra I scores and Algebra II scores were significantly correlated for both sexes but Algebra I and Algebra II scores correlated with Geometry scores for boys but not girls.

Multiple regression analysis using Algebra I and Algebra II as dependent variables, respectively, and sex, SAT-M and SAT-V as predictor variables found no multiple correlation significant beyond the simple predictive power of SAT-M ($r = .54$ for Algebra I and $r = .52$ for Algebra II). Geometry scores were not predicted singly or by any combination of sex, SAT-M, and SAT-V.

Table 19

Correlation Matrix of Test Scores for Students in School System Accelerated Mathematics Programs, by Sex[1]

	SAT-M	SAT-V	Alg. 1	Alg. 2	Geom.
SAT-M	—	.26* (65)	.42** (69)	.54** (49)	.29 (26)
SAT-V	.31** (171)	—	.19 (61)	.20 (49)	-.37 (19)
Alg.1	.59** (180)	.11 (166)	—	.46** (65)	-.14 (39)
Alg.2	.50** (150)	.02 (150)	.69** (166)	—	.28 (30)
Geom.	.32** (97)	.08 (83)	.40** (113)	.50** (91)	—

* $p < .05$ ** $p < .001$

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[1] Correlations for girls are shown in the upper right diagonal of the table, and correlations for boys are shown in the lower left diagonal. The number of cases for each correlation is shown in parentheses.

ATTITUDES AND INTERESTS

An assessment of the student's attitudes and interests relative to mathematics and future plans was included in the study to supplement the data on course-taking and achievement and hopefully contribute to a greater understanding of behavior. The following areas were included: 1) feelings about mathematics, 2) the influence of significant others, and 3) career and life style planning. Cross-tabulation comparisons between measures of acceleration, life style plans, and career goals and attitudinal measures were also made. The results are reported in the following sections.

Feelings About Mathematics

Some understanding of the basic feelings boys and girls have about mathematics may help explain sex differences in mathematics course-taking. Using the questionnaire and the F-S MAS to measure attitudes in this area, this study investigated: 1) reasons for studying advanced mathematics; 2) feelings about mathematics as a male domain; 3) the students' confidence in their ability to learn mathematics; and 4) their feelings about the special programs they participated in.

Reasons for Studying Advanced Mathematics

On the questionnaire students were asked to rate the importance of seven reasons to study mathematics beyond Algebra I. The question was worded as follows: "Below are reasons why some people do or do not study mathematics beyond Algebra I.

For each reason listed, check the column that best describes how important these reasons are for you." Students could select "Not Important", "Somewhat Important", or "Very Important" for each of these reasons: a) Mathematics will be important for my future career, b) Many of my friends will be taking advanced mathematics courses, c) Advanced mathematics is required to get into a good college, d) Mathematics teaches logical thinking, e) Mathematics is interesting to study, f) Mathematics is necessary in this technological age, and g) Mathematics is easy to learn. Space was left for students to write any reasons that were important to them but had been omitted from the list.

Tables 20 to 26 summarize the response distributions for the School System boys and girls, the Talent Search boys and girls, the Career Class girls, and the total boys and girls to this question, and the results of significant chi-square comparisons between the sexes within groups and between groups are noted in these tables. Chi-square tests of significance were performed between each of the following groups for each item in this question: Career Class girls vs. School System girls vs. Talent Search girls, total girls vs. total boys, Talent search boys vs. School System boys, School System girls vs. School System boys, Talent Search boys vs. Talent Search girls, Career Class vs. Talent Search girls, Career Class vs. School System girls, Career Class girls vs. Talent Search boys, and School System girls vs. Talent Search girls. The results are summarized in the following sections.

Important for Career

While a higher percentage of School System boys (74.0%) than School System girls (58.3%) indicated that the importance of mathematics for a future career was a very important reason for them to study advanced mathematics, a chi-square test of significance based on the three possible responses for the School System boys versus girls did not yield significant results, nor were there significant results from any other chi-square comparisons. Thus, boys and girls in the groups surveyed did not differ significantly in their perception of the relevance of mathematics to future career plans. The majority of both sexes in all groups saw it as a very important reason and only a small percentage in each group said it was not an important reason. These results are summarized in Table 20.

Insert Table 20

This result was surprising in view of an earlier study (Fox 1975) which posed a similar question. A random sample of 67 girls and 104 boys who participated in SMPY's 1974 Mathematics Talent Search were asked how important they thought mathematics would be for their future career. About two-thirds of the boys (62.1%) and only a third of the girls (33.8%) thought that mathematics would be very important for their future career, a significant difference. This contrasts with the 1978 Talent Search students surveyed were 70.2% of the boys and 75% of the girls thought that importance to career was a very important reason for studying advanced mathematics. The questions in the

Table 20

Distribution Percents of Responses to
"Mathematics Will Be Important for My Future Career"
as a Reason for Studying Mathematics Beyond Algebra I,
by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	5.6	36.1	58.3
	Boys	100	4.0	22.0	74.0
Talent Search	Girls	44	2.3	22.7	75.0
	Boys	47	2.1	27.7	70.2
Career Class	Girls	22	0	31.8	68.2
Total	Girls	102	2.9	29.4	67.6 *
	Boys	147	3.4	23.8	72.8

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

two surveys were worded somewhat differently but, it seems that, in the interim from 1974 to 1978, girls may have become more aware of the relevance of mathematics to a wide range of careers.

Friends

The second reason for studying advanced mathematics that the students were asked to consider was "Many of my friends will be taking advanced mathematics courses." The responses are summarized in Table 21. Chi-Square tests revealed a significant difference between the Talent Search boys and the School System boys ($p < .05$). Comparisons that just missed significance at the .05 level included School System girls vs. School System boys ($p = .054$), Career Class vs. Talent Search boys ($p = .07$), and School System girls vs. Talent Search girls ($p = .06$). No girls in the two treatment groups, the Career Class and the School System programs, said that this was a very important reason perhaps because these girls had already shown a willingness to leave their friends behind when they agreed to participate in either the Hopkins-based Career Awareness class or the School System programs which draw students from entire school systems and are predominantly male. The fact that School System boys seem to care more than either the Talent Search boys or the School System girls about their friends being in advanced

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Insert Table 21

Table 21

Distribution in Percents of Responses to "Many of my Friends will be Taking Advanced Mathematics Courses" as a Reason for Studying Mathematics Beyond Algebra I, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	83.3	16.7	0
	Boys	99	64.6	25.3	10.1
Talent Search	Girls	44	61.4	31.8	6.8
	Boys	47	53.2	44.7	2.1
Career Class	Girls	22	81.8	18.2	0
Total	Girls	102	73.5	23.5	2.9 *
	Boys	146	61.0	31.5	7.5

Significant Chi-Square Comparisons

Talent Search Boys versus School System Boys $\chi^2 = 7.19$ $p < .05$

* Does not total 100 percent due to rounding.

mathematics courses with them and yet still enrolled in the special classes suggests that these boys may have friends in the programs with them. It may be that boys as well as girls who do care about having their friends with them do not take the advanced courses unless their friends do too, and that the predominately male make-up of these classes makes this more of a problem for the girls and limits girls' participation in these classes.

College

"Advanced mathematics is required to get into a good college." was the next item in the question. The results are summarized in Table 22. There were no significant chi-square comparison results at the .05 level between any of the groups although one comparison just missed significance. Talent Search boys vs. School System boys was significant at the .059 level with the Talent Search boys considering this to be a more important reason than the school system boys.

Insert Table 22

Logical Thinking

The next reason given for studying mathematics was that "Mathematics teaches logical thinking." The students' responses are summarized in Table 23. Two comparisons were significant: Talent Search boys vs. School System boys ($p < .05$) and School

Table 22

Distribution in Percents of Responses to "Advanced Mathematics is Required to get into a Good College" as a Reason for Studying Mathematics Beyond Algebra I, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	2.8	44.4	52.8
	Boys	99	8.1	43.4	48.5
Talent Search	Girls	44	0	34.1	65.9
	Boys	46	4.3	26.0	69.6 *
Career Class	Girls	22	0	50.0	50.0
Total	Girls	102	1.0	41.2	57.8
	Boys	145	6.9	37.9	55.2

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

System girls vs. School System boys ($p < .05$) with more of the School System boys indicating that this is a very important reason to study mathematics than the students in either of the other groups.

Insert Table 23

Interesting

"Mathematics is interesting to study " was the next reason for studying mathematics that the students were asked to consider. The results are summarized in Table 24. No chi-square comparison on this question reached significance.

Insert Table 24

Technological Age

Students were asked to rate the importance of "Mathematics is necessary in this technological age " for studying advanced mathematics. These results are shown in Table 25. There were no significant chi-square comparisons for this factor.

Insert Table 25

Table 23

Distribution in Percents of Responses to "Mathematics Teaches Logical Thinking" as a Reason for Studying Mathematics Beyond Algebra I, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	8.3	58.3	33.3 *
	Boys	100	9.0	31.0	60.0
Talent Search	Girls	44	22.7	38.6	38.6 *
	Boys	47	8.5	53.2	38.3
Career Class	Girls	22	18.2	36.4	45.5 *
Total	Girls	102	16.7	45.1	38.2
	Boys	147	8.8	38.1	53.1

Significant Chi-Square Comparisons

Talent Search boys versus School System boys $\chi^2 = 6.98$ $p < .05$

School System girls versus School System boys $\chi^2 = 8.74$ $p < .05$

* Does not total 100 percent due to rounding.

Table 24

Distribution in Percents of Responses to "Mathematics is Interesting to Study" as a Reason for Studying Mathematics Beyond Algebra I, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important	
School System	Girls	36	13.9	44.4	41.7	
	Boys	99	14.1	43.4	42.4	*
Talent Search	Girls	43	11.6	34.9	53.5	
	Boys	47	12.8	36.2	51.1	
Career Class	Girls	22	9.1	45.5	45.5	
Total	Girls	101	11.9	40.6	47.5	
	Boys	146	13.7	41.1	45.2	

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

Table 25

Distribution in Percents of Responses to "Mathematics is Necessary in this Technological Age" as a Reason for Studying Mathematics Beyond Algebra I, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	0	52.8	47.2
	Boys	100	4.0	36.0	60.0
Talent Search	Girls	44	9.1	34.1	56.8
	Boys	47	4.3	53.2	42.6 *
Career Class	Girls	22	4.5	36.4	59.1
Total	Girls	102	4.9	41.2	53.9
	Boys	147	4.1	41.5	54.4

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

Easy

The final reason included in this question was that "Mathematics is easy to learn." The results are summarized in Table 26. In every group the boys consistently rated this as

Insert Table 26

a more important reason than the girls suggesting a trend in that direction, but chi-square tests did not produce significant results except that the comparison of total boys versus total girls just missed significance at the .05 level (p = .056). It is not fully clear from the question whether the girls are saying that Mathematics is not easy for them or whether it is simply not an important factor in their decision. It is possible, however, that if indeed they are less likely than the boys to feel that math is easy for them (even though the ability levels of the students in this study are comparable) that this feeling of inadequacy could contribute to girls' reluctance to take the more advanced mathematics courses.

Mathematics as a Male Domain

One hypothesis that has been postulated to explain girls' reluctance to take advanced mathematics courses is that there is a common perception that mathematics is a male domain. Girls may perceive that it is unfeminine to participate in mathematics courses where boys often outnumber girls, and may be reluctant to consider

Table 26

Distribution in Percents of Responses to "Mathematics is Easy to Learn" as a Reason for Studying Mathematics Beyond Algebra I, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	36.1	50.0	13.9
	Boys	100	41.0	39.0	20.0
Talent Search	Girls	43	37.2	51.2	11.6
	Boys	47	44.7	34.0	21.3
Career Class	Girls	22	36.4	54.5	9.1
Total	Girls	101	36.6	51.5	11.9
	Boys	147	42.2	37.4	20.4

Significant Chi-Square Comparisons

None

careers in mathematics and science where males are likely to outnumber females.

This study attemped to measure to what degree the perception of mathematics as a male domain was a concern to the students in the study. Measures used to assess this included the Mathematics as a Male Domain subscale of the Fennema-Sherman Mathematics Attitude Scale (F-S MAS) and a question on the questionnaire that was concerned with this issue.

Fennema-Sherman Mathematics Attitude Scale

The F-S MAS was administered to the students in the Talent Search, one School System accelerated class, and the all-girls' school group. A comparison of the boys and girls in the Talent Search revealed significant results. The girls had more positive scores than the boys; that is, they were less likely to report that mathematics was a male domain than were the boys. Mean scores for items on the Mathematics as a Male Domain Scale are shown, by sex, in Table 27. The girls had significantly higher mean scores in the non-stereotypic direction than did the boys on all items.

Insert Table 27

The distribution of the actual responses to the Mathematics as a Male Domain items are shown, by sex, in Table 28. It is the girls, rather than the boys, who tended to check "strongly agree"

Insert Table 28

Table 27 : Mean Scores and Variances for Items of the Mathematics as a Male Domain Scale of the F-S MAS for Talent Search Participants, by Sex

	Girls		Boys		
Items	$\bar{x}$	s^2	$\bar{x}$	s^2	t
1. Females are as good as males in geometry.	4.58	.46	3.90	.88	7.43**
2. Studying mathematics is just as appropriate for women as for men.	4.84	.23	4.32	.59	7.21**
3. I would trust a woman just as much as I would trust a man to figure out important calculations.	4.79	.23	4.15	.74	8.12**
4. Girls can do just as well as boys in mathematics.	4.75	.34	4.23	.64	6.64**
5. Males are not naturally better than females in mathematics.	4.11	1.93	3.63	3.72	2.55*
6. Women certainly are logical enough to do well in mathematics.	4.80	.26	4.28	.61	7.01**
7. It's hard to believe a female could be a genius in mathematics.	4.73	.71	4.35	.89	3.84**
8. When a woman has to solve a math problem, it is feminine to ask a man for help.	4.55	.76	3.90	1.06	6.15**
9. I would have more faith in the answer for a math problem solved by a man than a woman.	4.66	.53	4.08	1.04	5.85**
10. Girls who enjoy studying math are a bit peculiar.	4.76	.34	4.33	.79	5.09**
11. Mathematics is for men; arithmetic is for women.	4.75	.59	4.24	.66	5.86**
12. I would expect a woman mathematician to be a masculine type of person.	4.66	.41	4.22	.59	5.61**

* $p < .05$

** $p < .001$

Table 28 : Distribution of Item Response to the Mathematics as a Male Domain Scale of the F-S MAS for Talent Search Participants, by Sex

Items	Sex	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. Females are as good as males in geometry.	Girls	0.0	1.4	6.8	24.3	67.6
	Boys	1.6	3.7	28.6	34.9	31.2
2. Studying mathematics is just as appropriate for women as for men.	Girls	0.7	0.0	0.7	12.2	86.5
	Boys	0.5	2.1	9.0	41.8	46.6
3. I would trust a woman just as much as I would trust a man to figure out important calculations.	Girls	0.0	0.7	1.4	16.2	81.8
	Boys	0.5	4.2	14.8	40.7	39.7
4. Girls can do just as well as boys in mathematics.	Girls	0.7	0.7	1.4	17.6	79.8
	Boys	0.0	3.7	11.6	42.3	42.3
5. Males are not naturally better than females in mathematics.	Girls	11.5	5.4	6.1	14.2	62.8
	Boys	5.8	15.9	19.1	27.5	31.8
6. Women certainly are logical enough to do well in mathematics.	Girls	0.7	0.0	0.7	16.2	82.4
	Boys	0.5	2.1	10.6	42.3	44.4
7. It's hard to believe a female could be a genius in mathematics.	Girls	86.5	8.1	0.7	1.4	3.4
	Boys	56.1	29.1	11.1	1.6	2.1
8. When a woman has to solve a math problem, it is feminine to ask a man for help.	Girls	70.1	19.6	4.7	2.7	2.0
	Boys	36.5	27.0	29.1	5.3	2.1
9. I would have more faith in the answer for a math problem solved by a man than a woman.	Girls	77.0	15.5	5.4	0.7	1.4
	Boys	45.5	25.4	22.2	5.3	1.6
10. Girls who enjoy studying math are a bit peculiar.	Girls	81.1	16.2	1.4	0.7	0.7
	Boys	54.0	31.2	10.6	2.7	1.6
11. Mathematics is for men; arithmetic is for women.	Girls	87.2	6.1	4.1	0.0	2.7
	Boys	47.6	29.6	22.2	0.5	0.0
12. I would expect a woman mathematician to be a masculine type of person.	Girls	72.3	22.3	4.7	0.0	0.7
	Boys	40.7	42.9	14.8	1.1	0.5

to the positive items and "strongly disagree" to the negative ones. On four of these items (ones which reflect stereotyped thinking of mathematics as a male domain), as many as a fifth to a third of the boys were undecided or accepted the stereotypic image. For example, on item one, "Females are as good as males in geometry", approximately 92 percent of the girls agreed, but a third of the boys were undecided or disagreed. Item two, "Studying mathematics is just as appropriate for women as for men" was strongly endorsed by 86.5 percent of the females, but by less than half of the males. Almost twenty percent of the boys, but very few girls, were undecided or negative in response to "I would trust a woman just as much as I would trust a man to do an important calculation." On only one item, number seven, did more than half of the males respond with a strong response in support of female competence. That item was: "It is hard to believe a female could be a genius in mathematics."

The feeling one might get from analyzing the responses is that gifted boys believe a few atypical females can achieve in mathematics, but many are not at all confident that women in general are equal to men with respect to mathematics. The stereotype of the "atypical female" as good at mathematics is further supported by the responses to item five of the Male Domain Scale. Item five reads: "Males are not naturally better than females in mathematics." Over 20 percent of the boys disagreed with this statement and 19 percent were undecided. Less than a third disagreed strongly with the stereotype. (Even 17 percent of the girls disagreed with the idea of sexual equality in mathematics.)

Gifted and talented adolescent females have the same problems of all adolescent females with respect to developing their self-image of femininity. With respect to mathematics and femininity, two items point out the possible conflict between gifted girls and boys. On item eight, "When a woman has to solve a math problem, it is feminine to ask a man for help", less than 10 percent of the girls were undecided or agreed, while more than 36 percent of the boys were undecided or agreed. Over 14 percent of the boys were also undecided about the question of female mathematicians being masculine (#12). Only 41 percent strongly disagreed.

The number of girls in the school system class that completed the F-S MAS was so small that statistical comparisons are not very meaningful. Sex differences on the Mathematics as a Male Domain subscale, however, were consistent with the Talent Search group. The girls from the all-girls' school responded significantly ($p < .05$) lower, and more stereotypically, than the girls from the Talent Search but increassingly less stereotypically with age from 7th to 9th to 11th grade. Table 29 shows the means and Variances for the Mathematics as a Male Domain Subscale for all Groups.

Insert Table 29

Questionnaire

An item designed to assess the impact of the perception of Mathematics as a Male Domain was included on the questionnaire. This question was administered to the Talent Search boys and girls and the Career Class girls. The question reads as follows:

Table 29

Means, Variances and Significant t-Test Comparisons Between Groups on the Mathematics as a Male Domain Subscale of the F-S MAS.

Comparison Between School System Accelerated Class Boys and Talent Search Boys

Accelerated Class Boys		Talent Search Boys		t
$\overline{X}$	s^2	$\overline{X}$	s^2	
44.69	70.22	49.66	51.80	3.66**

Comparison Between Talent Search Boys and Talent Search Girls

Talent Search Boys		Talent Search Girls		t
$\overline{X}$	s^2	$\overline{X}$	s^2	
49.66	51.80	55.98	20.62	9.33**

Comparison Between Talent Search Girls and All-Girls' School

Talent Search Girls		All Girls' School		t
$\overline{X}$	s^2	$\overline{X}$	s^2	
55.98	20.62	53.50	39.52	2.85*

* $p < .05$

** $p < .01$

> Some people think that mathematics is a "masculine" activity and that boys are better than girls at mathematics. Do your classmates and friends at school hold this view? What makes you think they do or they don't? (For example, what do they say about girls who are "good at math")

The question was intentionally open-ended to elicit stories and feelings; it was possible, however, to categorize the responses as either denials or confirmations of stereotyping in the peer group. These results are summarized in Table 30. Chi-Square comparisons revealed significant differences between the responses of the boys and girls. The Talent Search boys denied evidence of their friends' stereotyping mathematics as a male domain to a greater extent than either the Talent Search girls ($p < .05$) or the Career Class girls ($p < .01$).

Insert Table 30

While many of the girls denied evidence of sex role stereotyping in mathematics (one, for example, said "it never occurred to me that sex had anything to do with mathematical ability"), examples of stereotyping by teachers, parents, and peers were cited by 21 percent of the Talent Search girls and 32 percent of the older Career Class girls. Some of the girls' comments follow:

Table 30

Distribution of Responses in Percents to Questionnaire Item Related to the Perception of Mathematics as a Male Domain, by Sex and Group.

Responses*

Group	1	2	3	4	5	Total Number
	percent	percent	percent	percent	percent	
Talent Search Boys	79	4	2	4	11	47
Talent Search Girls	52	18	16	5	9	44
Career Class Girls	50	9	32	0	9	22

* 1 = Complete denial of evidence of stereotyping

2 = Denial of stereotyping, but use of words like "most", "usually", etc., suggest some hesitation.

3 = Some definite evidence of stereotyping cited

4 = Strong evidence of stereotyping cited

5 = No answer, a "don't know" response, or a response that couldn't be classified into any of the other categories.

Significant Chi-Square Comparisons

Talent Search boys versus Talent Search girls $\chi^2 = 11.39$ $p < .05$

Talent Search boys versus Career Class Girls $\chi^2 = 14.75$ $p < .01$

"My friends do not hold this view, although some of my teachers do."

"Yes. My classmates think that mathematics is for boys because they think it is boring and they usually don't do very well in it. If a girl is good at mathematics, they call her a "brain" or a "genius" and put her in a special category of people — the people nobody really wants to talk to, except for help."

"Most of my male classmates consider males superior at anything. They regard mathematically intelligent females with disdain (usually due to envy or a feeling of uncertainty about their own status)."

"Some of the boys still say boys are smarter than girls. I must admit that at my school most of the girls who are really popular with guys don't do so well in school."

"My classmates and friends have accepted the fact that I am better than they in most aspects of mathematics; however, many of the boys think that other girls who are "good at math" are really strange and they don't go out with them often. I don't know why they accept me and not many others, unless it's because many of the others study a lot and are too straight and too concerned with their grades."

"My friends in school don't tend to be prejudiced about who should be good at math; however, all my girl friends tend to dislike math and don't plan to go as far in their study of math as the boys I know. They say that they (the girls) don't like math, and besides, what good will it do them, being girls?"

"I think that some people are good at math and some aren't, but I do think boys are encouraged more and encouragement does help."

"A lot of parents feel that boys are better than girls at math and, consequently, their children think so, too. Most of the higher math classes consist almost entirely of boys and in my opinion this is only because girls don't think they can compete with boys."

"In math class I have noticed surprise in boys when a girl does well in class or on a test."

The boys responses tended to be much shorter and were less likely to cite evidence of stereotyping. Some of their comments follow:

"Anybody who is good at math or anything gets called a 'brain'."

> "I cannot answer this question because I do not know of any exceptional math students (female) at my school."

> "Some people at my school say that boys are better than girls at almost any academic class."

> "I never heard this opinion before your other questionnaire. I think it's a dated question."

> "No. My school is very anti-chauvinistic."

> "They don't think like that. They just take it for granted that girls and boys are equal in math."

A number of students (three Talent Search boys, five Talent Search girls, and two Career Awareness Class girls), who denied evidence of stereotyping, indicated that both boys and girls who do well in mathematics are looked down on as "brains."

Discussion

The Talent Search girls gave more positive responses on the FS-MAS than did the Talent Search boys, but they answered less positively on the questionnaire. While most of the items on the F-S MAS were directed at asking them if they believe the study of mathematics is as appropriate for females as males, the questionnaire item asked if their friends thought mathematics was masculine. The girls, therefore, were more likely to deny that mathematics was masculine but to suggest that they were aware of stereotyping among their friends. The boys, on the other hand, answered more stereotypically for themselves, but were less aware of stereotyping among their friends.

These results suggest that girls may experience conflict between their own feelings about mathematics and their perception of other people's feelings. They may risk popularity by being too good at mathematics.

Confidence in Ability to Learn Mathematics

Based on the hypothesis that a lack of confidence in one's ability to do difficult mathematics might contribute to a reluctance to take advanced mathematics courses, the possibility of sex and/or group differences in the students' feelings of confidence in their ability to do mathematics was explored in this study. A study in 1974 on mathematically gifted seventh graders had found sex differences in self-confidence as measured by students' prediction of success in the Talent Search. It was hoped that the Confidence in Learning Mathematics Subscale of the F-S MAS would contribute to an understanding of the importance of this factor. This subscale was administered to the Talent Search boys and girls, one School System Accelerated Class, and the All-Girls' School Group. Means, variances and the results of t-test comparisons of the mean scores on this subscale are shown in Table 31.

Insert Table 31

Table 31

Means, Variances and Significant t-Test Comparisons Betweeen Groups on the Confidence in Learning Mathematics Subscale of the F-S MAS.

Comparison Between School System Accelerated Clas Boys and Talent Search Boys

Accelerated Class Boys		Talent Search Boys		t
$\overline{X}$	s^2	$\overline{X}$	s^2	3.29**
52.86	43.24	55.70	18.26	

Comparison Between Talent Search Boys and Talent Search Girls

Talent Search Girls		Talent Search Boys		t
$\overline{X}$	s^2	$\overline{X}$	s^2	4.34*
53.16	41.42	55.70	18.26	

Comparison Between Talent Search Girls and All-Girls' School Group

Talent Search Girls		All Girls' School		t
$\overline{X}$	s^2	$\overline{X}$	s^2	6.48**
53.16	41.42	44.90	94.77	

* $p < .05$ ** $p < .01$

Significant differences were found between the School System Boys and the Talent Search boys, between the Talent Search girls and the Talent Search boys, and between the Talent Search Girls and the All-Girls' School Group. The Talent Search boys, of all the groups, scored highest on this measure of confidence in learning mathematics. The All-Girls' School Group, not all necessarily very gifted in mathematics, scored the closet to the Wisconsin samples used by Fennema and Sherman, and lower than any of the gifted groups in the study. While it does not seem unusual that students gifted in mathematics would tend to exhibit more confidence in their abilities, one might have expected the girls in the All-Girls' School group to have expressed more self-confidence than the Wisconsin normative sample of girls in mixed-sex schools.

Mean scores, by item and sex, for the Talent Search Group on the Confidence Scale are shown in Table 32.

Insert Table 32

There were two items for which the differences were not statistically significant, items one and five ("Generally I have felt secure about attempting mathematics" and "I can get good grades in mathematics"). Although the differences on the remaining ten items were statistically significant, they were very small in magnitude, and both boys and girls tended to give positive responses. This can best be seen by looking at the distribution of responses.

Table 32: Mean Scores and Variances on Items of the Confidence in Learning Mathematics Scale of the F-S MAS for Talent Search Participants, by Sex

Item	Girls		Boys		
	$\bar{X}$	s^2	$\bar{X}$	s^2	t
1. Generally I have felt secure about attempting mathematics.	4.36	.62	4.48	.35	1.60
2. I am sure I could do advanced work in mathematics.	4.36	.59	4.55	.37	2.53*
3. I am sure that I can learn mathematics.	4.62	.38	4.78	.27	2.58*
4. I think I could handle more difficult mathematics.	4.11	.71	4.33	.61	2.48*
5. I can get good grades in mathematics.	4.71	.25	4.77	.27	1.07
6. I have a lot of self-confidence when it comes to math.	3.95	.79	4.33	.52	4.33**
7. I'm no good in math.	4.62	.37	4.78	.32	2.49*
8. I don't think I could do advanced mathematics.	4.50	.48	4.68	.37	2.54*
9. I'm not the type to do well in math.	4.43	.69	4.68	.25	3.42**
10. For some reason, even though I study, math seems unusually hard for me.	4.43	.79	4.70	.31	3.41**
11. Most subjects I can handle O.K., but I have a knack for flubbing up math.	4.51	.74	4.78	.26	3.59**
12. Math has been my worst subject.	4.55	.85	4.84	.21	3.77**

* $p < .05$

** $p < .001$

The distribution of item responses to the Confidence Scale is shown in Table 33. With the exception of items four and six, 95 percent of the boys agreed with the positive items (1-6) and disagreed or strongly disagreed with the positive items (7-12). With the exception of items one and six, at least 85 percent of the girls agreed or strongly disagreed with the negative items. In some cases the differences between the boys and girls was a matter of degree of positiveness, as in item seven.

Insert Table 33

When one looks at the content of the items, the response patterns make sense in relation to previous research findings on women and mathematics. The item to which the largest percentage of girls responded "strongly agree" was Item 5, "I can get good grades in mathematics." The positive items to which the largest percentage of girls responded "disagree" or "undecided", were Items 6, 4, and 2, respectively:

"I have a lot of self-confidence when it comes to math",
"I think I could handle more difficult mathematics", and
"I am sure I could do advanced work in mathematics."

The negative items for which the largest percentage of girls were undecided or agreed, were 12, 11, and 9, respectively:

"Math has been my worst subject",
"Most subjects I can handle, but I have a knack for flubbing up math", and "I'm not the type to do well in math."

Table 33: Distribution of Item Responses to the Confidence Scale of the F-S MAS for Talent Search Participants, by Sex

Items	Sex	Strongly Disagree	Disagree	Un-decided	Agree	Strongly Agree
1. Generally I have felt secure about attempting mathematics.	Girls Boys	0.7 0.0	3.4 0.5	5.4 3.2	39.7 44.4	50.7 51.9
2. I am sure I could do advanced work in mathematics.	Girls Boys	0.0 0.0	2.7 1.1	9.5 3.2	36.5 35.5	51.4 60.3
3. I am sure that I can learn mathematics.	Girls Boys	0.0 0.5	0.7 0.0	5.4 1.6	25.0 16.4	68.9 81.5
4. I think I could handle more difficult mathematics.	Girls Boys	0.0 0.5	5.4 2.1	14.2 9.5	44.6 39.2	35.8 48.7
5. I can get good grades in mathematics.	Girls Boys	0.0 0.5	0.0 0.0	2.0 1.6	25.0 17.5	73.0 80.4
6. I have a lot of self-confidence when it comes to math.	Girls Boys	0.0 0.0	8.1 1.6	17.6 10.1	46.0 42.3	28.4 46.0
7. I'm no good in math.	Girls Boys	67.6 82.0	28.4 15.9	2.7 1.1	1.4 0.0	0.0 1.1
8. I don't think I could do advanced mathematics.	Girls Boys	59.5 73.0	32.4 24.3	6.8 1.1	1.4 1.1	0.0 0.5
9. I'm not the type to do well in math.	Girls Boys	58.9 69.3	30.4 29.1	7.4 1.6	2.0 0.0	1.4 0.0
10. For some reason, even though I study, math seems unusually hard for me.	Girls Boys	60.1 74.1	31.1 22.8	2.7 2.1	4.1 1.1	2.0 0.0
11. Most subjects I can handle O.K., but I have a knack for flubbing up math.	Girls Boys	68.9 81.0	19.6 17.5	6.1 1.1	4.7 0.0	0.7 0.5
12. Math has been my worst subject.	Girls Boys	75.0 86.2	12.8 12.7	5.4 0.5	5.4 0.0	1.4 0.5

Thus, some girls know they make good grades but still persist in projecting future failures or a denial of their ability -- even though this is a sample of girls who are among the most mathematically talented girls in the nation (at least the top two percent on in-grade tests such as the Iowa Tests of Basic Skills).

Of course, some of the highly able boys respond similarly to these items, but the difference still seems to be meaningful in practical terms. Twice the percentage of girls than boys were uncertain or negative about their ability to handle more difficult math, and well over twice the percentage of girls than boys admitted to lacking confidence when it comes to mathematics.

Feelings about Special Programs

Items were included on the questionnaires administered to the students in the School System Accelerated Mathematics classes and the Career Awareness class to assess their feelings about these special programs.

School System Accelerated Mathematics Classes

The students in the School System Accelerated classes were asked three questions designed to assess their feelings about the programs. The results are shown in Table 34.

Insert Table 34

The first question asked the students was "What was the most enjoyable aspect of the special mathematics classes." Four choices were offered along with an option of "other" where the student could specify another

Table 34

Distribution in Percents of Responses of School System Boys and Girls to Questionnaire Items Evaluating Their Accelerative Mathematics Classes

Question	Girls Responding	Boys Responding
18. The most enjoyable aspect of the special mathematics classes was:		
a) The chance to meet other students who were as interested in mathematics as I was	3 %	7 %
b) The challenge of doing difficult work	14 %	17 %
c) The opportunity to move ahead in mathematics	67 %	69 %
d) The fact that the teacher was very knowledgeable and enthusiastic about mathematics	6 %	2 %
e) Other	11 %	5 %
Total number of responses:	36	96
19. The least enjoyable aspect of the special mathematics classes was:		
a) Too much homework	31 %	28 %
b) The work was too difficult	14 %	5 %
c) There were too many students in the class who were smarter than I	9 %	2 %
d) The fact that the class could not be held during the regular school day and had to be held either after school or on Saturdays	26 %	35 %
e) Other	20 %	30 %
Total number of responses:	35	94
20. Being in the special mathematics class has:		
a) Greatly increased my interest in studying mathematics	39 %	49 %
b) Somewhat increased my interest in studying mathematics	28 %	27 %
c) Had no effect on my interest in studying mathematics	25 %	14 %
d) Decreased my intrest in studying mathematics	8 %	7 %
e) Other	0 %	3 %
Total number of responses:	36	96

aspect. Students were asked to choose only one option. In a few cases multiple responses were given anyway, and these were included in the "other" category for tabulating purposes. The majority of both boys (69 percent) and girls (67 percent) selected (c) as the most enjoyable aspect: "The opportunity to move ahead in mathematics." "The challenge of doing difficult work" was the second most popular reason but was chosen by only 17 percent of the boys and 14 percent of the girls. A Chi-Square test of significance between the boys and girls on responses to this question yielded no significant differences.

The second question in this section asked the students for the least enjoyable aspect of the classes. "Too much homework" was cited by 28 percent of the boys and 31 percent of the girls. "The fact that the class could not be held during the regular school day and had to be held either after school or on Saturdays was cited by 35 percent of the boys and 26 percent of the girls. The differences between the boys' and girls' responses were not significant.

The final question in this section asked the students what effect the special class had had on their interest in studying mathematics. Forty-nine percent of the boys and 39 percent of the girls said that being in the special mathematics class had greatly increased their interest in studying mathematics. "Somewhat increased..." was selected by 27 percent of the boys and 28 percent of the girls, "had no effect..." was selected by 14 percent of the boys and 25 percent of the girls, and "decreased my interest..." was selected by 7 percent of the boys and 8 percent of the girls. The sex differences were not statistically significant.

Career Awareness Class

The questionnaire administered to the Career Awareness class included several questions designed to assess the girls' feelings about the program and to help evaluate whether the goals of the class had been met.

The first question was "What, if any, benefits do you feel you got from participating in the Career Awareness program at Hopkins in the summer of 1977?" All of the students said that they had benefited from the class and mentioned such benefits as interaction with high ability peers, increased interest in mathematics and increased awareness of careers. Some of the girls' answers to this question follow:

> "I feel I became more aware of the many careers that were open to me. I also feel that I became more interested in mathematics than I had been before participating in the Career Awareness class."
>
> "Because of going to the Career Awareness program I became more educated as to exactly what fields were open to me. I also had the unique opportunity to be in a class with students of similar abilities."
>
> "I saw different careers and it got me thinking about what I want to be. It also reinforced my original idea that I can be anything I want to be. I learned a lot and met some really nice people."
>
> "Teachers began to realize that I was not an average student when they found out about these programs. My parents have begun to expect me to do more with myself which causes me to work harder and, all around, I have really enjoyed Johns Hopkins."

The students were asked to list specific aspects of the class they liked and disliked. Some of the students mentioned a strong liking or disliking of a particular unit, such as Statisitcs, but no units appeared to be unpopular with more than a few students, and other students seemed to especially enjoy those same units. Other things students said they liked included: the teachers, the other students, the feeling of independence walking around campus, the computer, and learning about new careers. Aspects some students did not like included the drive to Hopkins, the hot classrooms, and that the class was too short.

The next question the students were asked was: "At any time, did you feel like you wanted to drop out of the Career Awareness Class? Why? If you didn't, what made you stay?" Sixteen students said "no", one did not respond to the question, and five indicated that at some point they considered dropping out. Three of these had problems with the Statistics unit, either finding it difficult or not liking it, but decided to stay and liked the other topics. One girl liked Statistics but not the other topics. The fifth girl said she missed her friends at the pool but her parents wouldn't let her quit.

The next question asked the following:

> "Did being in the class affect the way you feel about yourself with respect to mathematics or how you feel about yourself in general? (For example, has it changed your ideas about your career or educational goals? Do you like mathematics more or less than you did before?)"

Eighteen of the students responded positively to this question while three said it had no effect, and one did not answer. Some of the girls' answers follow.

> "I now enjoy math more than I ever have, and I never really noticed my mathematical potential until then."
>
> "I probably like math more because I can see where it will help me in the future. It doesn't seem pointless any more."
>
> "It made me realize that mathematics is important to almost any career."
>
> "I want to have a career in which math takes some part. The class reinforced my feelings of continuing on with math and not stopping just because I have gotten all the credits I need. I don't know whether I like math better than I did before, but now I realize how important math is."

Finally, the students were asked: "If a younger friend, brother or sister was invited to participate in a Career Awareness class like the one you participated in and asked your advice and opinion about the class, what would you tell him or her?" Eighteen students said they would recommend the class, two said possibly (one of these said that the person would have to be willing to work hard), and two did not respond.

Significant Others

Adult female mathematicians often state that support from significant others was extremely helpful and in some cases the crucial factor in aiding them to reach their goals (Luchins in press). In addition, Helson (in press) reported that female mathematicians were likely to have close relationships with and be influenced by their fathers. Casserly (in press) reports that teachers were very influential in encouraging girls to take Advanced Placement courses in mathematics and the physical sciences. The person and the exact nature of the influence may vary but it is clear that perceived support from others can be important to encourage the continual study of mathematics by young women.

One of the objectives of this study, was to examine the influence of significant others on the lives of the mathematically able students inthe study in order to see if there are sex differences in the students perceptions of the encouragement they receive from those people who are closest to them. Since peer support and perception of friends are discussed in another section of this report, the discussion in this section will focus on fathers, mothers, and teachers. Data were collected from two sources: the Fennema-Sherman Math Attitude Scale (F-S MAS) and the questionnaire. The F-S MAS was administered to 339 students from the Talent Search, the 7th, 9th and 11th grade students in an all girls private school and one School System group. Three subscales are related to students' perceptions of the attitudes toward mathematics and supportiveness of mothers, fathers, and teachers.

The Questionnaire, administered to the subsample of 44 girls and 47 boys drawn from the Talent Search, the School System classes, and the Career class, included questions related to significant others which were open ended. These were categorized for comparison purposes and also provide anecdotal information.

Results of Fennema Sherman Math Attitude Scale

The boys and girls in the study who were given the F-S MAS have more positive attitudes on the mother, father and teacher subscales than do the Wisconsin population on whom the scales were normed as shown in Table 35. The mathematically able students score at or near the 80 percentile when compared to the Wisconsin group except that the boys from the school system class score in the 75th percentile on the teacher scale. Because only 8 girls from that School System group participated in the testing, statistical comparisons using the girls group would not be meaningful, but these girls do not seem to differ from the other groups.

The girls from the all girls private school appear to have less positive perceptions of support than do the other samples. The percentile rank of mean scale scores for the F-S MAS are shown by grade in Table 35 . The seventh and ninth graders do not differ in their perception of paternal support but there is a drop for 11th graders

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Insert Table 35

Table 35

Percentile Ranks on the Scales for Mother Father and Teacher on the Fennema Sherman Attitude Scale by Group and Sex*

Group	Sex	N	Grade	Mother	Father	Teacher
Talent Search	Girls	148	7	88	84	86
	Boys	189	7	86	86	86
School System	Girls	8	7	85	78	79
	Boys	35	7	85	82	75
All Girls School	Girls	42	7	64	74	59
	Girls	50	9	74	74	51
	Girls	38	11	59	61	69
Total for All Girls School	Girls	130	7, 9, 11	63	68	64

* based on norms for the Wisconsin group

who fall in the 61 percentile on that scale compared to the Wisconsin norms. The ninth grade girls percieve maternal support stronger than do the girls in 7th grade. These patterns are reversed for teacher support, with the 11th grade girls the most positive and the 9th grade girls the least positive. It would seem that among the girls from the all girls private school perception of parental support decreases as their perception of teacher support increases. This would seem to agree with some of Casserly's (in press) findings on the importance of teacher support for girls in Advanced Placement Courses.

Significant differences were found on the scales for mother , father and teacher ($p < .001$) when the seventh grade girls from an all girls private school were compared to the seventh grade Talent Search girls. Table 36 shows that the Talent Search girls had higher mean scores for all three scales. Since the Talent Search girls are more mathematically able than the girls in the all girls school, it is not surprising that they perceived stronger support for mathematics from significant others than did the other group of girls. This support could account for their willingness to participate in the Talent Search and for their more positive attitudes on the other scales of the F-S MAS as well. (See earlier section on feelings about mathematics.)

Insert Table 36

Table 36

Means and Variances for Scale Scores of F-X MAS for 7th Grade Girls in Talent Search and All-Girls' School

Scale	Talent Search		All-Girls' School		t
	$\bar{X}$	s^2	$\bar{X}$	s^2	
Mother	53.81	42.20	47.05	64.29	5.59**
Father	54.15	39.50	50.43	45.18	3.33**
Teacher	49.26	54.60	43.36	49.21	4.62**

** $p < .001$

Questionnaire Responses on Significant Others

Students were asked to describe any special experience or person that was a strong factor in helping them become interested in and/or good in mathematics, to describe how the person or event influenced them, and when the influence took place. Although this was an open ended question, students responses were grouped in the following categories: mother, father, parents, teacher, and special program. (See Table 37) If students mentioned their mother and/or father specifically, they were counted in that category; if they wrote parents without specific reference to either one their response was listed in the parent category. Some students mentioned a special mathematics program in which they had participated. These responses were listed separately from those which specifically referred to a teacher.

Insert Table 37

Many of the students did not list anyone or any experience as being an influential factor in their interest in mathematics. They wrote that they were good at mathematics as it was easy, or fun, and that was why they liked it, not because of any external factors. One boy, exhibiting the extreme of the self-propelled individual wrote, "In the first grade, I noticed that girls tended to be more intelligent than boys and so I worked over my math grades to shoot over the girls."

Table 37

Percentage of Students Who Noted the Positive Influence of a Person or Program Upon Their Mathematical Interest or Ability, by Group and Sex*

Group	Sex	N	Mother	Father	Parents	Teachers	Special Program
School System	Girls	36	11	13.9	11.1	50	19.4
	Boys	100	5	23	4	49	16
Talent Search	Girls	44	18.2	25	6.8	36.4	13.6
	Boys	47	10.6	14.9	8.5	34.0	10.6
Career	Girls	22	0	31.8	22.7	40.9	27.3
Total	Girls	102	11.8	22.5	11.8	42.2	18.6
	Boys	147	6.8	20.4	5.4	43.8	14.3

* Numbers do not add up to 100 due to multiple responses

The perceived influence of fathers was stronger than mothers for all groups, but especially in the Career class where no girl stated her mother had been a strong factor in helping her develop mathematical interests. Considering the number of mothers who drove them to the summer class, this was indeed surprising. Both boys and girls mentioned that fathers who had mathematically related jobs helped them to see the fun and usefulness of mathematics. One girl wrote that her father encouraged her to help him at work and this job involved mathematics. Another girl from a school system class wrote, "In working with my father, I found so many uses for the things I had learned and I found a need to learn so much more." Another wrote, "Father always helped me with a smile which proved to me that math could be fun and interesting". In some cases it was expectation not encouragement that was remembered. One girl wrote "My father is good in math and he expected me to be good, too". Although the girls in the Career class did not mention their mothers, and very few of the boys remember specific maternal encouragement, some of the other girls did cite their mothers as major influences. Mothers were mathematicians and/or math teachers who encouraged their daughters. One wrote, "My mother often gave me lists of problems to solve. I liked to show her how much I had learned and I liked her to be proud of me". Another girl remembered her mother always saying "you'll want to take Algebra and Geometry when you grow up because they're so much fun". One girl mentioned that her best friend's mother was a "doctor in mathematics" and she gave her puzzles and logic games to do. It was not clear whether the woman's child was given similar attention or whether the girl was singled out because her friend's mother perceived she was mathematically able.

The students in the School System classes and girls who attended the Career class wrote of teacher's influence more often than the students from the Talent Search. Further examination of the questionnaires showed that most of them were referring to the teachers of special mathematics classes run by school systems in which they had participated, crediting the teachers, rather than the special programs with their interest in mathematics. Some students, however, remember teachers they had when they were much younger. One boy wrote that his second grade teacher put him in the "carrot" group in 2nd grade math and she made him aware of his mathematics abilities. Curiously, 3 other students from that school system, mentioned their 2nd grade teacher. In another school system, it was a first grade teacher who was mentioned by several of the students. Because of confidentiality, no names were available, but it would be interesting to learn if the children from the same school district were referring to the same teachers. Although no category was developed for guidance personnel because many elementary schools do not have them on staff, several students from another school system mentioned the influence of a sixth grade "coordinator" who recognized their math talent and counseled them into special 7th grade math programs.

Age at which First Positive Experience was Recalled

Students were also asked to indicate the age when they first recalled a specific experience related to someone or something arousing their interest in mathematics. Not all the students responded to this question. Both the number of responses and the percentage that number represents appear in Table 38 . From that Table, it is clear that except for a small percentage of students, the first positive experience related to mathematics does not take place in the pre-school years. For all groups except the career class, the first remembered positive experience was between the ages of 5 - 10 for most students, although an equal percentage of Talent Search girls wrote ages 11 - 12. Over 50% of the girls who attended the Career Class remember their first positive influence when they were 11 - 12. The girls in the Career Class also remembered teachers more often providing positive influences.

Insert Table 38

Examination of the questionnaire responses showed that all but 2 girls who wrote 11 - 12 as the age range of their first remembered positive experience, had written of a teacher who had an effect on their interest in mathematics. Their comments about teachers fell into 2 categories and in some cases the girls mentioned both: The math teachers either in regular classes or special programs made math interesting to learn and exciting for the first time and/or the teachers had actively encouraged the girls to participate in the Talent Search at which time the extent of the girls mathematical talent was recognized. Further examination of the questionnaire responses for the girls in the other groups indicated a similar pattern. Most of the girls who indicated their first time influence as being in the years between 11 and 12 also felt it was teachers that had influenced them.

Table 38

Distribution of Student Responses to Age at Which They Recall First Positive Influence of a Person or Program on Their Mathematical Interest or Ability, By Group and Sex*

			Age in Years					
Group	Sex	N	0-4	5-10	11-12	13	13+	
School System	Girls	28	3 (10.7)	11 (39.3)	9 (32.1)	5 (17.9)	0 (0)	
	Boys	85	8 (9.4)	32 (37.6)	25 (29.4)	14 (16.5)	6 (7.1)	
Talent Search	Girls	36	7 (19.4)	13 (36.1)	13 (36.1)	3 (8.3)	0	**
	Boys	29	5 (17.2)	14 (48.3)	9 (31.0)	1 (3.4)	0	**
Career	Girls	18	2 (11.1)	4 (22.2)	10 (55.6)	1 (5.6)	1 (5.6)	**
Total	Girls	82	12 (14.6)	28 (34.1)	32 (39.0)	9 (11.0)	1 (1.2)	**
	Boys	114	13 (11.4)	46 (40.4)	34 (29.8)	15 (13.2)	6 (5.3)	**

* The numbers standing alone refer to the actual number of responses. The numbers inside the parenthesis ( ) are percentages.

** Does not add up to 100 due to rounding

Future Plans Relating to Education, Careers and Life Styles

The exact nature of the relationship between career plans and mathematics course-taking behavior is not clear, but research suggests that girls with early and definite career plans are more likely to train for and pursue careers as adults, and that early interest in careers of a mathematical and scientific nature leads to more favorable course-taking behavior related to mathematics and science. (Astin, 1968, 1974; Astin and Myint, 1971; Rossi, 1965) Several items on the questionnaire, therefore, were devoted to feelings about careers and future life style plans. In this section, differences among the various groups on those items related to careers and life style plans will be discussed.

Reasons for Working

Questions were designed to see if students perceive working as something they will have to do as adults or as an optional activity that will be enjoyable for them or useful to society. The students were asked how important (not important, somewhat important, or very important) they considered each of the following five reasons for working: a) Society and my family expect me to work; b) It will probably be financially necessary for me to work; c) I feel an obligation to my self to develop and use my talents; d) I feel an obligation to society to develop and use my talents; and e) I would be bored if I did not work. The students' were then asked to indicate which of the five statements was the most important reason for them to work.

Society and my family expect me to work

Few students in any group felt that society's expectation for them to work was very important; the majority of the students described this as only "somewhat important." The distribution of responses shown in Table 39 , however, reveals that in the Career Class

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Insert Table 39

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over 50% of the girls answered that that was "not important" to them.

A chi-square analysis of this item revealed a number of significant differences between the groups in the study. Sex differences on this item were found between the boys and girls in the School System population and the total number of boys and girls in the study. The Career Class was significantly different from both the boys and the girls of the Talent Search population. Examination of the percentages shows that the boys are perceiving society's expectation that they will work as more important than the girls.

A three way chi-square analysis of response distributions among the girls in the Career Class, Talent Search, and School System barely missed significance ($p = .0556$) with the differences being that a larger percentage of the Talent Search girls than any other group stated that society's expectation was "very important", and a larger percentage of the Career Class, than the other two groups, indicated it was "not important."

The Financial Necessity for Working

Respondents were asked whether they felt it was financially necessary for them to work. Sex differences were found for the

Table 39

Distribution in Percents of Responses to "Society and My Family Will Expect Me to Work" as a Reason to Work by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	36.1	61.1	2.8
	Boys	100	23.0	54.0	23.0
Talent Search	Girls	44	25.0	59.1	15.9 *
	Boys	47	14.9	68.1	17.0
Career Class	Girls	22	54.5	40.9	4.5
Total	Girls	102	35.3	55.9	8.8
	Boys	147	20.4	58.5	21.1

Significant Chi-Square Comparisons

School System girls vs. boys $\chi^2 = 8.09$ $p < .05$

Career Class vs. Talent Search girls $\chi^2 = 6.15$ $p < .05$

Career Class vs. Talent Search boys $\chi^2 = 12.21$ $p < .01$

Total boys vs. girls $\chi^2 = 10.74$ $p < .01$

* Does not total 100 percent due to rounding

mathematically gifted boys and girls in the study. Examination of the response distributions as shown in Table 40 shows that

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Insert Table 40

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the differences are due largely to the fact that more boys than girls feel the financial necessity of their working will be "very important," while more girls than boys see it as only "somewhat important".

Obligation to Self

The majority of students in every group felt their obligation to themselves to develop and use their talents was an important reason to work, with very few believing it was not important at all. The response distributions are shown in Table 41 . It is interesting

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Insert Table 41

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to note that no girls selected "not important" as a choice to this item. Chi-square analysis on this item showed significant differences between the boys and girls in the study, with the girls feeling a greater obligation to themselves to develop their talents than the boys. No significant differences were found in any of the subgroups in the study.

Table 40

Distribution in Percents of Responses to "Financially Necessary to Work" as a Reason to Work by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	5.6	36.1	58.3
	Boys	100	4.0	18.0	78.0
Talent Search	Girls	44	2.3	29.5	68.2
	Boys	47	2.1	21.3	76.6
Career Class	Girls	22	4.5	36.4	59.1
Total	Girls	102	3.9	33.3	62.7 *
	Boys	147	3.4	19.0	77.6

Significant Chi-Square Comparisons

Total boys vs. girls $\chi^2 = 6.83$ $p < .05$

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*Does not total 100 percent due to rounding

Table 41

Distribution in Percents of Responses to "Obligation to Self" as a Reason to Work by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	0	16.7	83.3
	Boys	100	12.0	18.0	70.0
Talent Search	Girls	44	2.1	21.3	76.6
	Boys	47	0	13.6	86.4
Career Class	Girls	22	0	22.7	77.3
Total	Girls	102	0	16.9	83.3
	Boys	147	8.8	19.0	72.1 *

Significant Chi-Square Comparisons

Total girls vs. boys $\chi^2 = 10.20$ $p < .01$

*Does not total 100 percent due to rounding

Obligation to Society

In the total group, boys and girls differed with respect to their responses to "Obligation to Society" as a reason to work. More boys than girls rated this as "not important" while more girls than boys rated this as "very important". The response distribution to this question is shown in Table 42. This difference in response

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Insert Table 42

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pattern was significant in a comparison between School System boys and girls, however there were no differences between the boys and girls in the Talent Search.

Boredom

Significant sex differences were found on responses to "I would be bored if I did not work", between the girls and boys in the School System population, and the boys and girls in the total population in the study. Significant differences were also found between the boys in the Talent Search and the boys in the School System population on this item because the Talent Search boys considered it more important than the School System boys. In general, the girls seemed to consider it "very important" with approximately 45% of the School System and Career Class girls, and close to 55% of the Talent Search girls choosing that category. Differences among the girls' groups appear in the "not important" and "somewhat important" categories. The response distributions are shown in Table 43 .

Insert Table 43

Table 42

Distribution in Percents of Responses to "Obligation to Society" as a Reason to Work by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	13.9	41.7	44.4
	Boys	100	32.0	43.0	25.0
Talent Search	Girls	44	15.9	54.5	29.5 *
	Boys	47	17.0	53.2	29.8
Career Class	Girls	22	9.1	54.5	36.4
Total	Girls	102	13.7	50.0	36.3
	Boys	147	27.2	46.3	26.5

Significant Chi-Square Comparisons

School System girls vs. boys $X^2 = 6.52$ $p < .05$

Total girls vs. boys $X^2 = 7.10$ $p < .05$

*Does not total 100 percent due to rounding

Table 43

Distribution in Percents of Responses to "I would be bored if I did not work" as a Reason to Work, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	11.1	44.4	44.4 *
	Boys	100	28.0	46.0	26.0
Talent Search	Girls	44	18.2	27.3	54.5
	Boys	47	12.8	40.4	46.8
Career Class	Girls	22	13.6	40.9	45.5
Total	Girls	102	14.7	36.3	49.0
	Boys	147	23.1	44.2	32.7

Significant Chi-Square Comparisons

School System boys versus girls	$\chi^2 = 6.14$	$p < .05$
School System boys versus Talent Search boys	$\chi^2 = 7.67$	$p < .05$
Total boys versus girls	$\chi^2 = 7.20$	$p < .05$

* Does not total 100 percent due to rounding

Most Important Reason

After the students rated each of the five statements separately they were asked which of the five items seemed to them to be the most important reason. Response distributions are shown in Table 44.

Insert Table 44

Only two items received a sizeable percentage of answers from the students, "It will be financially necessary for me to work", and "I feel an obligation to myself to use my talents." Almost half of the boys in every group stated that the fact that it would be financially necessary for them to work was their most important reason for working, while about a third said that obligation to myself to use my talents was the most important reason. The girls' pattern was just the opposite with the largest percentage of girls saying the obligation to use their talents was most important, while the second most chosen response was the financial necessity of working.

"Society expects me to work" was chosen by none of the girls and only one boy. About 14% of the School System girls checked "Obligation to Society", but far fewer students in the other groups did so. A surprising 20% of the Talent Search girls checked boredom as the most important reason, whereas few other students chose this factor as the most important reason.

Table 44

Distribution in Percents of Responses to "Most Important Reason for Working" By Group and Sex

Responses	School System		Talent Search		Career Class	Total	
	Girls (N=36)	Boys (N=97)	Girls (N=44)	Boys (N=46)	Girls (N=22)	Girls (N=102)	Boys (N=143)
Society will expect me to work	0	1	0	0	0	0	.7
Financially necessary to work	16.7	49.5	27.3	50.5	27.3	23.5	49.7
Obligation to self to develop talents	63.9	38.1	45.5	39.1	68.2	56.9	38.5
Obligation to society to develop talents	13.9	7.2	6.8	4.3	4.5	8.8	6.3
Bored if not working	5.6*	4.1*	20.5*	6.5*	0	10.8	4.9

Significant Chi-Square Comparisons

School System boys vs girls $\chi^2 = 19.6$ $p < .01$

Total boys vs girls $\chi^2 = 12.6$ $p < .05$

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* Does not add up to 100 because of rounding

Highest Level of Education to Which Students Aspire

Because training is a necessary component of most high level positions, Question 8 was designed to ascertain the students' long-term educational plans. Of five possible choices, the students had to select the one which best described the upper limits of their educational goals for the future. The choices were: a) high school only, b) vocational, trade or business school, c) two year or junior college, d) four year college and e) graduate or professional school after college. All groups in the study answered this question, including the students who were involved in the all girls accelerated class and the control groups. The results are shown in Table 45 .

Insert Table 45

Since very few students chose the options which required less than 4 years of college, options a, b, and c were treated as one category on the table.

The majority of students in all groups plan to continue their education beyond college. It is interesting that both groups of girls who participated in an all girls program at Hopkins which included an emphasis on career counseling and introduced female role models with high level careers, had the highest percentage of any group who planned to go to graduate school.

Table 45

Responses in Percents to Highest Level of Education Expected to Complete By Group and Sex

Group	Sex	Number	Less than College Degree	Four Year College	Graduate or Professional School
School System	Girls	68	0	35.3	64.7
	Boys	158	2.5	37.3	60.1 *
Talent Search	Girls	44	0	31.8	68.2
	Boys	47	0	21.3	78.7
Career Class	Girls	22	0	18.2	81.8
Total Group	Girls	134	0	31.3	68.7
	Boys	205	2.0	33.7	54.4 *
Hopkins Accelerated Class		21	4.8	9.5	85.7
Control Girls		20	5.0	25.0	70
Control Boys		20	0	20.0	80

Significant Chi Square Comparisons

Girls Career Class and Hopkins Accelerated Class vs. School System Girls	$\chi^2 = 4.73$ $p < .05$
Girls Career Class and Hopkins Accelerated Class vs. All other girls	$\chi^2 = 4.57$ $p < .05$
Girls Career Class and Hopkins Accelerated Class vs. School System Boys	$\chi^2 = 7.32$ $p < .01$
Girls Career Class and Hopkins Accelerated Class vs. all boys	$\chi^2 = 5.38$ $p < .05$
Girls Career Class and Hopkins Accelerated Class vs. all other groups	$\chi^2 = 5.47$ $p < .05$

Significant differences were found when the two girls' groups with career components were compared to school system girls, school system boys, the total of the other girls' groups, and the other boys' groups in the study, and the total of all the other groups in the study. Examination of the table indicates that the differences are due primarily to the fact that the girls who had attended classes with career education built in to the curriculum were preparing to stay in school longer in order to get greater training.

The few students who did not plan to complete college were all from the School System classes, three from School System C and one from School System D. All the boys are planning mathematically related, technically oriented careers such as radio or computer technician. One boy left high school early with a high school equivalency degree to join the Marines but plans to be a Nuclear Weaponry Technician.

The two girls who did not anticipate completing college have goals less related to mathematics and different from each other. One has decided upon a career in the theater and does not feel mathematics or higher education is important to her. The other, from the control group which received no intervention, took high school mathematics through Calculus, took Physics and got A's in all her courses. She is presently working as a clerk in a local dairy store. She clearly is not working at the level of her ability.

Factors in Choosing A Job

Questions 12, 13, and 14 were designed to see if there were sex or group differences in students' projected reasons for choosing a career when they were ready to enter the job market. Included in the question were traditional items relating to salaries and status as well as items which have become important in recent years, such as flexibility of time.

Students were asked to respond by checking either "not important", "somewhat important", or "very important" to the following reasons for selecting a job: a) the amount of mathematics needed, b) the amount of education needed, c) the cost of the education needed, d) belief that I will be able to do the job well, e) belief that I will enjoy the job, f) opportunity to use my special abilities to the fullest, g) opportunity to earn a high salary, h) having a position that is looked up to by others, i) possibility of a flexible time schedule, j) challenge of difficult work, k) many job openings in the field, l) opportunities to be helpful to others or useful to society, and m) choice to work with people rather than things. Students were also asked to indicate the answer they felt was most important in their selection of a job or career. In addition, space was left for additional comments if the students chose to make them.

Amount of Mathematics Needed

This option was intended to see if students would consider the amount of mathematics needed at a job as an important factor when choosing their career field.

There were no sex differences on this item, as shown in Table 46 . Significant differences were found between the Career Class and the Talent Search girls. This difference is due to the fact that very few Talent Search girls (9.10%), but 31.8% of the Career Class see the amount of mathematics as not important, while 43.2% of the Talent Search girls see it as very important compared to only 22.7% of the Career Class.

Insert Table 46

Amount of Education Needed

There were no differences between boys and girls in the importance of educational training as a factor in their future job choice, as shown in Table 47 . Differences between the Career Class and the Talent Search girls almost reached significance (p = .0596) but no other group differences were found. In general, students checked "very important" most frequently, with "somewhat important" as a secondary choice, and "not important" getting less than 15% of all groups.

Insert Table 47

Table 46

Distribution in Percents of Responses to "Amount of Mathematics Needed" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	27.8	33.3	38.9
	Boys	98	15.3	41.8	42.9
Talent Search	Girls	44	9.1	47.7	43.2
	Boys	47	25.5	38.3	36.2
Career Class	Girls	22	31.8	45.5	22.7
Total	Girls	102	20.6	42.2	37.3 *
	Boys	145	18.6	40.7	40.7

Significant Chi-Square Comparisons

Career Class versus Talent Search girls $\chi^2 = 6.25$ $p < .05$

* Does not total 100 percent due to rounding.

Table 47

Distribution in Percents of Responses to "Amount of Education Needed" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	5.6	38.9	55.6 *
	Boys	98	8.2	31.6	60.2
Talent Search	Girls	44	4.5	25.0	70.5
	Boys	47	14.9	31.9	53.2
Career Class	Girls	22	13.6	45.5	40.9
Total	Girls	102	6.9	34.3	58.8
	Boys	145	10.3	31.7	57.9 *

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

Cost of Education

There were no significant sex or group differences with respect to the cost of education as shown in Table 48. The responses indicated

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Insert Table 48

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that the cost of education was only "somewhat important" to most of the students with about 49% of the students checking that response and about 25% of them indicating a preference for "very important" and "not important."

Ability To Do The Job Well

Sex differences, as shown in Table 49 , were found between the mathematically gifted boys and girls on the importance of their

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Insert Table 49

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ability to do the job well as a factor in their future job selection. Examination of the percentages in Table 49 , indicates that the boys feel it somewhat less important than the girls. The pattern of responses is the same, however, with most of the students checking "very important", a few checking "somewhat important", and almost none checking "not important".

How Much I Will Enjoy The Job

Almost all the students felt that how much they enjoy the job was a "very important" reason to choose a job, with very few choosing

Table 48

Distribution in Percents of Responses to "Cost of Education Needed" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	22.2	63.9	13.9
	Boys	99	27.3	48.5	24.2
Talent Search	Girls	44	25.0	43.2	31.8
	Boys	47	29.8	51.1	19.1
Career Class	Girls	22	36.4	36.4	27.3 *
Total	Girls	102	26.5	49.0	24.5
	Boys	146	28.1	49.3	22.6

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

Table 49

Distribution in Percents of Responses to "Ability to Do Job Well" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	0	16.7	83.3
	Boys	98	6.1	18.4	75.5
Talent Search	Girls	44	0	11.4	88.6
	Boys	47	0	25.5	74.5
Career Class	Girls	22	0	13.6	86.4
Total	Girls	102	0	13.7	86.3
	Boys	145	4.1	20.7	75.2

Significant Chi-Square Comparisons

Total boys versus girls $\chi^2 = 6.78$ $p < .05$

"somewhat important", and none choosing "not important". There were no sex or group differences at all on this item. The responses are shown in Table 50 .

Insert Table 50

Use My Abilities To The Fullest

Although most of the students in all groups considered using their abilities to the fullest a "very important" reason for selecting a job, sex differences were found for the girls and boys in the study, as well as for the students in the School System classes, as shown in Table 51 . Fewer boys than girls considered this a "very important" reason for a job selection. It is interesting to note that none of the girls considered this reason "not important" while seven boys chose that response.

Insert Table 51

Earn High Salary

There was a slight trend for the boys to view the opportunity to earn a high salary as more important than the girls, but there were no significant sex or group differences on this question as shown in Table 52 . Except for the boys in the School System classes

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Insert Table 52

Table 50

Distribution in Percents of Responses to "How Much I Will Enjoy the Job" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	0	11.1	88.9
	Boys	99	0	7.1	92.9
Talent Search	Girls	44	0	6.8	93.2
	Boys	47	0	2.1	97.9
Career Class	Girls	22	0	9.1	90.9
Total	Girls	102	0	8.8	91.2
	Boys	146	0	5.5	94.5

Significant Chi-Square Comparisons

None

Table 51

Distribution in Percents of Responses to "Using my Abilities to the Fullest" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	0	16.7	83.3
	Boys	99	7.1	30.3	62.6
Talent Search	Girls	44	0	25.0	75.0
	Boys	47	0	29.8	70.2
Career Class	Girls	22	0	22.7	77.3
Total	Girls	102	0	21.6	78.4
	Boys	146	4.8	30.1	65.1

Significant Chi-Square Comparisons

School System boys versus girls	$\chi^2 = 6.05$	$p \leq .05$
Total boys versus girls	$\chi^2 = 8.07$	$p < .05$

Table 52

Distribution in Percents of Responses to "Earn High Salary" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	16.7	50.0	33.3
	Boys	99	8.1	43.4	48.5
Talent Search	Girls	44	9.1	52.3	38.6
	Boys	47	2.1	59.6	38.3
Career Class	Girls	22	13.6	54.5	31.8 *
Total	Girls	102	12.7	52.0	35.3
	Boys	146	6.2	48.6	45.2

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

whose most frequent response was "very important", answers to this item were concentrated in the "somewhat important" category, with the "very important" category receiving fewer responses and "not important" being the least common response.

Being Looked Up To By Others

There were no sex or group differences on respondents feelings about a job that is looked up to by others, as shown in Table 53.

Insert Table 53

Approximately half of the students in any group felt this was a "somewhat important" factor in choosing a job. It is interesting that none of the girls in the Career Class felt being looked up to by others was "very important" to them.

Flexible Time Schedule

It was believed that a flexible work schedule would be more important to the girls who might be thinking about juggling home and work responsibilities, but no sex differences were found in this category, as shown in Table 54 . In fact, more boys seemed to

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Insert Table 54

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feel flexible time was "very important" than girls. Most of the students seemed to feel this was only "somewhat important", however.

Table 53

Distribution in Percents of Responses to "Being Looked up to by Others" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important	
School System	Girls	36	25.0	61.1	13.9	
	Boys	99	27.3	56.6	16.2	*
Talent Search	Girls	44	25.0	61.4	13.6	
	Boys	47	31.9	53.2	14.9	
Career Class	Girls	22	13.6	54.5	31.8	*
Total	Girls	102	26.5	62.7	10.8	
	Boys	146	28.8	55.5	15.8	*

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

Table 54

Distribution in Percents of Responses to "Flexible Time Schedule" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	13.9	63.9	22.2
	Boys	99	17.2	52.5	30.3
Talent Search	Girls	44	18.2	56.8	25.0
	Boys	47	14.9	46.8	38.3
Career Class	Girls	22	27.3	40.9	31.8
Total	Girls	102	18.6	55.9	25.5
	Boys	146	16.4	50.7	32.9

Significant Chi-Square Comparisons

None

Challenge of Difficult Work

Although the majority of students thought the challenge of difficult work was "somewhat or very important", significant sex differences were found on this item for the students in the study. Examination of responses in Table 55 shows this is due primarily

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Insert Table 55

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to the fact that more of the boys see it as "not important" than the girls. In fact, only one girl in the entire study felt the challenge of difficult work was "not important." Sex differences between the students in the School System classes were also significant. This is due to the fact that the boys checked "very important" more often than the girls (55.6% vs. 47.2%). Ten of the boys felt it was "not important", while none of the girls did.

Many Job Openings in the Field

Although no sex differences were found on the item dealing with job openings, there was a significant difference between the girls in the Talent Search and the girls in the School System classes, as shown in Table 56 . It is clear that the Talent Search girls perceive

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Insert Table 56

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job openings as being "very important" in choosing a job, more than the girls in School System classes. The boys patterns are almost identical to each other with approximately half of them choosing "somewhat important", one-third choosing "very important", and one-sixth choosing "not important" at all.

Table 55

Distribution in Percents of Responses to "Challenge of Difficult Work" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important	
School System	Girls	36	0	52.8	47.2	
	Boys	99	10.1	34.3	55.6	
Talent Search	Girls	44	0	43.2	56.8	
	Boys	47	4.3	42.6	53.2	*
Career Class	Girls	22	4.5	31.8	63.6	*
Total	Girls	102	1.0	44.1	54.9	
	Boys	146	8.2	37.0	54.8	

Significant Chi-Square Comparisons

School System boys versus girls $\chi^2 = 6.27$ $p < .05$

Total boys versus girls $\chi^2 = 6.77$ $p < .05$

* Does not total 100 percent due to rounding.

Table 56

Distribution in Percents of Responses to "Many Job Openings in the Field" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important	
School System	Girls	36	13.9	66.7	19.4	
	Boys	99	15.2	52.5	32.3	
Talent Search	Girls	44	9.1	43.2	47.7	
	Boys	47	17.0	51.1	31.9	
Career Class	Girls	22	9.1	68.2	22.7	
Total	Girls	102	10.8	56.9	32.4	*
	Boys	146	15.8	52.1	32.2	*

Significant Chi-Square Comparisons

School System girls versus Talent Search girls $\chi^2 = 6.96$ $p < .05$

* Does not total 100 percent due to rounding

Opportunities To Be Helpful

Sex differences in the School System population emerged on the item relating to the chance to be helpful to others or useful to society, as shown in Table 57 . None of the girls in the

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Insert Table 57

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group viewed this as "not important", while 14% of the boys did. In addition, 65.6% of the girls viewed it as "very important", while only 37.4% of the boys felt that way.

The pattern of responses for the boys shows less variability than the girls with about half of both groups of boys feeling being helpful was "somewhat important", followed by "not important". The pattern for the girls is less clear. While both the School System girls and the Talent Search girls checked "very important" most often, more of the School System girls chose that category than the Talent Search girls. The Career Class clearly checked "somewhat important" most often, and "very important" only received responses from 22.7% of that group. Although 9% of both the Career Class and Talent Search girls responded "not important" none of the School System girls checked that response.

Chance To Work With People

No significant sex or group differences were found on the responses to the chance to work with people rather than things as a factor in job selection, as shown in Table 58 . Although the

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Insert Table 58

Table 57

Distribution in Percents of Responses to "Opportunities to be Helpful to Others or Useful to Society" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important
School System	Girls	36	0	44.4	55.6
	Boys	99	14.1	48.5	37.4
Talent Search	Girls	44	9.1	43.2	47.7
	Boys	47	17.0	51.1	31.9
Career Class	Girls	22	9.1	68.2	22.7
Total	Girls	102	6.9	41.2	52.0 *
	Boys	146	13.0	48.6	38.4

Significant Chi-Square Comparisons

School System girls versus boys $\chi^2 = 7.25$ $p < .05$

* Does not total 100 percent due to rounding.

Table 58

Distribution in Percents of Responses to "Chance to Work With People Rather Than Things" as a Factor in Job Selection, by Group and Sex

Group	Sex	Total Number of Persons	Not Important	Somewhat Important	Very Important	
School System	Girls	35	17.1	57.1	25.7	*
	Boys	99	28.3	50.5	21.2	
Talent Search	Girls	44	25.0	43.2	31.8	
	Boys	47	44.7	27.7	27.7	*
Career Class	Girls	22	27.3	36.4	36.4	*
Total	Girls	101	22.8	46.5	30.7	
	Boys	146	33.6	43.2	23.3	*

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

pattern of responses was slightly different for the boys, the only group which checked "not important" more often than the other two categories were the Talent Search boys. The School System boys checked "somewhat important" most often followed by "not important". The girls checked "somewhat important" most often, followed by "very important" (except for the Career Class girls, who checked them equally as often).

Most Important Factor in Job Selection

After the students had responded to the items related to factors in choosing a future job, they were asked to review the list and choose the one item which seemed most important to them. Their answers are shown in Table 59 . Clearly their belief that they will enjoy the job is perceived as the most important factor in choosing a job for all groups . Differences do emerge when one looks at the category that received the second most frequent responses, however. For the boys, the second most frequent response was related to the opportunity to earn a high salary. Only 5% of the girls in the study considered the opportunity to earn a high salary important enough to choose that response. The second and third most frequent responses for the School System girls were their belief that they would do the job well and the chance to be helpful to society. The Talent Search girls checked their belief that they would do the job well and the chance to use their abilities to the fullest with equal frequencies (18.2) and the girls in the Career Class chose the oppor-

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Insert Table 59

Table 59: Distribution in Percents of Responses to Most Important Reason for Job Selection By Group and Sex

	Group						
	School System		Talent Search		Career Class	Total	
Responses	Girls (N=36)	Boys (N=99)	Girls (N=44)	Boys (N=45)	Girls (N=21)	Girls (N=101)	Boys (N=144)
Amount of Mathematics required for job	0	0	0	2.2	0	0	0.7
Amount of education needed for job	0	1.0	0	2.2	0	0	1.4
Cost of the education	0	1.0	2.3	0	0	1.0	0.7
Ability to do job well	11.1	13.1	18.2	2.2	4.8	12.9	9.7
Will enjoy job	58.3	44.4	36.4	66.7	52.4	47.5	51.4
Opportunity to use abilities to fullest	5.6	11.1	18.2	4.4	9.5	11.9	9.0
Chance to earn high salary	2.8	14.1	6.8	8.9	4.8	5.0	12.5
Will be looked up to	0	0	2.3	0	0	1.0	0
Possibility of flexible time schedule	2.8	2.0	0	2.2	0	1.0	2.1
Challenge of difficult work	2.8	7.1	6.8	8.9	9.5	5.9	7.6
Many job openings	2.8	2.0	0	0	0	1.0	1.4
Opportunity to be helpful	8.3	3.0	6.8	2.2	14.3	8.9	2.8
Chance to work with people	5.6*	1.0 *	2.3*	0 *	4.8 *	4.0*	0.7

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* Does not add up to 100 because of rounding

tunity to be helpful to society as their second most frequent response with the opportunities to use their talents and the challenge of difficult work being the third most frequent choice.

Career and Life Style Plans for the Future

Since the students in this study were all of approximately equal and high ability, especially in mathematics, it could be assumed that they should all be striving for productive careers, but Rossi (1965) suggests that family responsibilities create problems for women who want productive careers. No such assumption for boys is found in the literature.

Questions 15, 16, and 17 on the questionnaire explored the relationship between future career plans and family roles for both boys and girls. A series of options was presented, representing different combinations of career and life style plans. The students were asked to choose the one option that was closest to their own plans for the future.

The first three options involved a full time commitment to a career. They were: a) to have a full time career, marry and have children; b) to have a full time career, marry but have no children; and c) to have a full time career and remain unmarried. Option d was for a part time career while children were small and full-time before they were born and after they had grown. Options e to g represented weaker commitments towards careers. Option e was for a part time career always, option f for a full time career only until marriage, and option g was for a full time career only until children were born and then not work. Option h represented the weakest possible commitments to a career, never to work at all. The results of this question will be analyzed for sex and group differences in this section. In addition, the Talent Search group will be analyzed further based on the strength of their career commitment.

Plans for Self

To make the results more meaningful, the choices were collapsed into three main categories. The first category related to plans for full time careers always. The second category allowed for a part-time work period while children were small, but was essentially a lifetime commitment to a career. The third category included all the choices which indicated a weak career commitment, interrupted or part-time careers and no careers at all. The results are shown in Table 60.

Insert Table 60

Sex differences on future life style plans were found for the mathematically gifted boys and girls in our study and for both subgroup populations, i.e., the students in the Talent Search and the School System classes. Further analysis of the table shows

Table 60

Distribution in Percents of Responses to "Career and Life Style Plans for Self and Spouse" by Group and Sex

			Total Number of Persons	Full Time Career Always	Full Time & Part Time Career Combination	Limited Career Expectations	
School System	Girls	Self	35	48.6	45.7	5.7	
		Spouse	33	93.9	6.1	0	
	Boys	Self	96	95.8	4.2	0	
		Spouse	85	9.4	34.1	56.5	
Talent Search	Girls	Self	44	45.5	29.5	25.0	
		Spouse	44	95.5	2.3	2.3	*
	Boys	Self	46	97.8	2.2	0	
		Spouse	44	18.2	25.0	56.8	
Career Class	Girls	Self	22	45.5	50.0	4.5	
		Spouse	21	90.5	4.8	4.8	*
Total	Girls	Self	101	46.5	39.6	13.9	
		Spouse	98	93.9	4.1	2.0	
	Boys	Self	142	96.5	3.5	0	
		Spouse	129	12.5	31.0	56.6	*

Significant Chi-Square Comparisons

Career and Life Style Choice for Self

School System girls versus boys	$\chi^2 = 41.37$	$p < .001$
Talent Search girls versus boys	$\chi^2 = 34.87$	$p < .001$
Total girls versus boys	$\chi^2 = 80.62$	$p < .001$
School System versus Talent Search versus Career Class girls	$\chi^2 = 13.37$	$p < .01$
School System girls versus Talent Search girls	$\chi^2 = 8.67$	$p < .05$
Career girls versus Talent Search girls	$\chi^2 = 7.07$	$p < .05$

Career and Life Style Choices for Spouse

School System girls versus boys	$\chi^2 = 77.15$	$p < .001$
Talent Search girls versus boys	$\chi^2 = 53.61$	$p < .001$
Total girls versus boys	$\chi^2 = 151.50$	$p < .001$

Life Style Self versus Life Style Spouse

School System girls	$\chi^2 = 16.93$	$p < .001$
School System boys	$\chi^2 = 137.34$	$p < .001$
Talent Search girls	$\chi^2 = 30.23$	$p < .001$
Talent Search boys	$\chi^2 = 59.15$	$p < .001$
Career Class girls	$\chi^2 = 11.11$	$p < .01$
Total girls	$\chi^2 = 55.23$	$p < .001$
Total boys	$\chi^2 = 195.74$	$p < .001$

Girls' Life Style Choices for Self versus Boys' Life Style Choices for Spouse

School System	$\chi^2 = 34.5$	$p < .001$
Talent Search	$\chi^2 = 7.7$	$p < .05$
Total	$\chi^2 = 52.6$	$p < .001$

* Does not total 100 percent due to rounding.

that approximately 95% of the boys expect lifetime full time careers, while approximately 45% of the girls checked responses in that category. Even though they chose the full time career option, one of the boys commented that he would like to have a family business so every one could share the work, and another said that he would like to be able to work out his own hours so that he would have a lot of free time to spend with his spouse and children, but most of the boys did not comment. Less than 5% of the boys opted for part time work while their children were small but approximately 40% of the girls chose that option. None of the boys chose responses in the limited career category, while almost 14% of the girls did.

No differences between the boys in the Talent Search and School System groups were found but significant differences were found among the three groups of girls in the study. There was virtually no difference in the percentage of girls who chose full time career options, approximately 45% of each group. The differences are largely due to the fact that 45 - 50% of the girls who were involved in a program, either the Career Class at Hopkins, or the classes run by school systems, chose part time work only when their children were small more often than the girls in the Talent Search (30% of them chose that option). While only 5% of the girls in special programs chose options in the third category, the weakest in terms of career commitment, 25% of the girls in the Talent Search chose options in that category.

When the Talent Search girls were analyzed further some interesting results were obtained. The girls were divided into three groups by life style preferences, and compared on their answers to the questions relating to reasons to work, factors in job selection, and their planned years of education. Significant differences within the Talent Search girls were found for "I feel an obligation to myself" as a reason to work, and for the following factors in job selection, using their abilities to the fullest, available job openings and cost of education. In addition, there were significant differences within the girls on the highest level of education they hoped to obtain. These are shown in Tables 61 to 65.

Insert Tables 61-65

Examination of the responses shows that the girls planning full time careers and those planning a full time, part time combination follow a similar pattern in that they feel their obligation to themselves to use their talents to the fullest is a very important reason to work (90% who want full time careers and 100% of those who chose the full time, part time combination). Only 63% of the girls with limited career expectations checked "very important" for thatreason. In addition, 80% of the girls who want full time careers and 76.9% of those who chose the full time, part time career option plan to go to graduate or professional school while the majority of the girls with limited career options (63.6%) plan only to complete 4 years of college. Within the Talent Search girls, therefore, those who plan careers do so

Table 61

Distribution in Percents of Responses to "Obligation to Self" as a Reason to Work, by Life Style Plan for Talent Search Girls

Life Style Plan	Total Number of Persons	Not Important	Somewhat Important	Very Important
Full Time Career	20	0.0	10.0	90.0
Full Time and Part Time Career Combination	13	0.0	0.0	100.0
Limited Career Expectation	11	0.0	36.4	63.6

$X^2 = 7.10 \quad p < .05$

Table 62

Distribution in Percents of Responses to "Use One's Abilities" as a Factor in Job Selection by Life Style Plan for Talent Search Girls

Life Style Plan	Total Number of Persons	Not Important	Somewhat Important	Very Important
Full Time Career	20	0.0	35.0	65.0
Full Time and Part Time Career Combination	13	0.0	0.0	100.0
Limited Career Expectation	11	0.0	36.4	63.6

$X^2 = 6.16 \quad p < .05$

Table 63

Distribution in Percents of Responses to "Available Job Openings" as a Factor in Job Selection by Life Style Plan for Talent Search Girls

Life Style Plan	Total Number of Persons	Not Important	Somewhat Important	Very Important
Full Time Career	20	20.0	45.0	35.0
Full Time and Part Time Career Combination	13	0.0	23.1	76.9
Limited Career Expectation	11	0.0	63.6	36.4

$\chi^2 = 10.40 \quad p < .05$

Table 64

Distribution in Percents of Responses to "Cost of Education"
as a Factor in Job Selection
by Life Style Plan for Talent Search Girls

Life Style Plan	Total Number of Persons	Not Important	Somewhat Important	Very Important
Full Time Career	20	35.0	20.0	45.0
Full Time and Part Time Career Combination	13	23.1	69.2	7.7
Limited Career Expectation	11	9.1	54.5	36.4

$\chi^2 = 10.34 \quad p < .05$

Table 65

Distribution in Percents of Responses to "Highest Level of Education" by Life Style Plan for Talent Search Girls

Life Style Plan	Total Number of Persons	Four-Year College	Graduate or Professional School
Full Time Career	20	20.0	80.0
Full Time and Part Time Career Combination	13	23.1	76.9
Limited Career Expectation	11	63.6	36.4

$\chi^2 = 6.88 \quad p < .05$

because of their perceived obligation to themselves, and are intending to get as much training as necessary while those who have limited career aspirations plan fewer years of education, and feel a lesser need to fulfill themselves through a career.

When actually selecting a job, however, girls choosing a full time - part time career option feel it is very important to choose a job that will enable them to use their abilities to the fullest (100%) and one in which there were available job openings (76.9%), while about 65% of both the Talent Search girls planning full time careers and those with limited career options feel it is very important to use their abilities to the fullest and only about 35% of them are very concerned with the available job openings. Twenty percent of the girls who expect to have full time careers do not care about available job openings at all.

The cost of education reveals a totally different pattern for all three groups, with the full time career girl choosing "very important" most often, followed by "not important," the full time, part time combination girls choosing "somewhat important" as a clear majority (69.2%), and the girls with limited career expectations choosing "somewhat important" most often, followed by "very important."

Life Style Preferences for Spouse

Because the influence of the opposite sex is sometimes strong, especially during adolescence, Question 16 dealt with what life style preferences the boys and girls in our study would choose for their mates when they married. They were asked to review the choices in the previous question but this time choose their preference for their future spouse. The analysis used was the same as in the question related to life style preferences for oneself.

Some of the children on the previous question had chosen not to marry and therefore did not respond to a question about their future spouse. In addition, some students indicated they would not presume to choose for their spouse. There were fewer responses to this question, therefore, than to the previous one.

Again, sex differences were found for the total number of boys and girls in the study, as well as the Talent Search and School System subgroups as shown in Table 60 . No differences were found between the two groups of boys in the study nor among the three groups of girls. Approximately 95% of the girls expected their husbands to have full time careers while only 12.5% of the boys expected their wives to work full time. Approximately 31% of the boys anticipated their wives would work part time only when their children were small but full-time before they were born and after they were grown, but almost 57% of them anticipated a weak commitment to a career for their wives.

Life Style Self vs. Life Style Spouse

All groups showed significant differences in their own expectations for future life styles compared to those they expected for their mates as shown in Table 60 . The boys expect to work full time, but most of them do not expect their wives to do so. Less than 50% of the girls expect to work full time, but more than 90% of them expected their husbands to do so.

When analysis was done comparing the boys' preferences for their wives with the girls' preferences for themselves and the girls' preferences for their husbands with the boys' preferences for themselves, some interesting results were obtained. There were no differences between the girls' expectations for their husbands future life styles and the boys' expectations for themselves. The boys expect to work full time and the girls expect their husbands to work full time. Only a few girls indicated that they would like their husbands to have part time careers and some commented that they should both arrange to be home with the children, but such answers were rare. When the girls' expectations for their future were compared with the boys' expectations for their future wives, however, significant differences appeared. The girls have stronger commitments to careers than the boys expect for their future wives. Explanations on some of the questionnaires from some of the boys indicated they were most concerned with child care and assumed it would be their wives who would stay home with the children. One boy said it would depend on how much they each liked their respective careers but he was an exception.

One of the girls was quite defensive about the question and wrote, "I can understand your interest in my plans for the future but... find it none of your business." No boy seemed upset with the question.

Some of the girls comments reflect the conflict they may consciously or unconsciously face. One girl wrote "I don't want to marry anyone. I would rather live with someone. I might have children, but I haven't decided yet. I would want my boyfriend to have a full time job." Another girl commented, "... possibly remain single and adopt two children, probably deaf, under 8 or 9." One girl who checked "full time career, marry and have children" as her future life style choice commented that she would work only if she had to be financially independent.

One girl's profile and comments seem to contain all the inconsistencies which may be going through many girls' minds. Her career choices were "politician- President of the U.S., tutor-mathematics, and public lawyer." She felt her obligation to herself to use her talents was the most important reason to work, and the challenge of difficult work was the most important factor in choosing a job. She checked the full time career but remain unmarried option and commented, "If I do become a politician, I have no objection to marriage, but I would seriously object to having children. If I'm not a politician, I feel I would prefer not to be married, but if I do get married, I have no objection to children." It is not surprising when one realizes that the boys have no conflict between their own plans and those of their opposite sex peers, while the girls do face more conflict when planning for the future. The girls are less sure of their career plans and must balance their desires for a career with their perception of their male peers' lack of supportiveness of a strong commitment to a full time career.

Career Choice

On this part of the questionnaire, students were asked to list their first, second and third choice for future careers The answers were grouped into the six categories developed by John Holland for his vocational interest inventories, i.e., investigative, realistic, artistic, social, economic, and conventional. Because all of the students in the study were mathematically talented, it was expected that aspirations toward investigative careers would predominate. Table 66 shows the results from this question. Chi square

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Insert Table 66

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comparisons were made between the boys and girls in the School System population, the Talent Search population, between each treatment and control group of girls and between the two groups of boys based on Table 66. No sex or group differences were found. The majority of students in every group choose careers in the investigative category. Careers in the artistic category were the second most popular choice by all the groups except the Talent Search girls who chose careers in the economic category more often. The social category received minimum responses except from two girls groups, the Career Class and the Talent Search girls, 9% of whom chose careers in that category. Both the realistic and the conventional categories received minimum responses.

Table 66: Distribution in Percents of Responses to
First Choice Career
By Sex and Group

			Category of Career Preferences					
Group	Sex	Total Number of Persons	Investigative	Realistic	Artistic	Social	Economic	Conventional
School System	Girls	61	63.9	3.3	13.1	3.3	13.1	3.3
	Boys	143	70.6	2.1	13.3	2.1	9.8	2.1
Talent Search	Girls	43	53.5	2.3	11.6	9.3	18.6	4.7
	Boys	47	70.2	6.4	10.6	2.1	10.6	0 *
Career Class	Girls	22	68.2	4.5	18.2	9.1	0	0
Total	Girls	126	61.1	3.2	13.5	6.3	12.9	3.2
	Boys	190	70.5	3.2	12.6	2.1	10.0	1.6

* does not total 100 percent due to rounding.

Career Choices were then recategorized into investigative and non-investigative careers. The results are summarized in Table 67.

Insert Table 67

Other questionnaire items were then examined by investigative career choice as well as sex and group.

Career Interest and Reasons to Study Mathematics

On four of the seven reasons for studying mathematics beyond Algebra I, differences were found between students who had investigative career goals and those who had non-investigative goals. There were no significant differences in response distributions on the importance of "getting into a good college", "necessary in this technological age", or "mathematics is easy to learn." A detailed discussion of the significant differences follows.

Future Career

Table 68 shows that girls who reported an investigative career choice were more likely than girls with other career interests to rate the value of mathematics for their future career as "very important." This difference was also significantly different within the School System and Talent Search groups. The pattern was

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Insert Table 68

Table 67

Distribution in Percents of Responses to
First Career Choice
Categorized by Investigative versus Non-Investigative
by Sex and Group

Group	Sex	Total Number of Persons	Investigative	Non-Investigative
School System	**Girls**	61	63.9	36.1
	Boys	143	70.6	29.4
Talent Search	**Girls**	43	53.5	46.5
	Boys	47	70.2	29.8
Career Class	**Girls**	22	68.2	31.8
Total	**Girls**	126	61.1	38.9
	Boys	190	70.5	29.5

Table 68

Distribution in Percents of Responses to "Importance of Mathematics for Future Career" as a Reason for Studying Mathematics Beyond Algebra I, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	15	0.0	20.0	80.0
		no	7	0.0	57.1	42.9
	School System	yes	19	0.0	21.1	78.9
		no	14	14.3	50.0	35.7
	Talent Search	yes	23	4.3	8.7	87.0
		no	20	0.0	40.0	60.0
	Total	yes	57	1.8	15.8	82.5 *
		no	41	4.9	46.3	48.8
Boys	School System	yes	63	3.2	17.5	79.4 *
		no	28	7.1	28.6	64.3
	Talent Search	yes	33	0.0	15.2	84.8
		no	14	7.1	57.1	35.7 *
	Total	yes	96	2.1	16.7	81.3 *
		no	42	7.1	38.1	54.8

Significant Chi-Square Comparisons

School System girls	$\chi^2 = 7.23$	$p < .05$
Talent Search girls	$\chi^2 = 6.42$	$p < .05$
Total girls	$\chi^2 = 12.51$	$p < .01$
Talent Search boys	$\chi^2 = 12.00$	$p < .01$
Total boys	$\chi^2 = 10.65$	$p < .01$

* Does not total 100 percent due to rounding.

true for the Career Class girls but did not reach statistical significance. A similar significant difference was found for the total group of boys and within the Talent Search group.

Friends

Girls who had non-investigative career plans were more likely than the boys to say that the fact that "my firends will be studying advanced mathematics" was a "not very important" reason as shown in Table 69 . No other comparisons were significant.

Insert Table 69

Logical Thinking

The statement that "mathematics teaches logical thinking" was said to be a "very important" reason by more boys than girls who had investigative career interests as seen in Table 70 . No other comparisons were significant.

Insert Table 70

Interesting

Students with investigative career choices were more likely to rate "mathematics as interesting to study" as "very important" and less likely to say it was a "not very important" reason, than students

Table 69

Distribution in Percents of Responses to "Many of my Friends Will be Taking Advanced Mathematics Courses" as a Reason for Studying Mathematics Beyond Algebra I, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	15	73.3	26.7	0.0
		no	7	100.0	0.0	0.0
	School System	yes	19	78.9	21.1	0.0
		no	14	85.7	14.3	0.0
	Talent Search	yes	23	56.5	39.1	4.3 *
		no	20	65.0	25.0	10.0
	Total	yes	57	68.4	29.8	1.8
		no	41	78.0	17.1	4.9
Boys	School System	yes	63	69.8	17.5	12.7
		no	27	55.6	37.0	7.4
	Talent Search	yes	33	60.6	39.4	0.0
		no	14	35.7	57.1	7.1 *
	Total	yes	96	66.7	25.0	8.3
		no	41	48.8	43.9	7.3

Significant Chi-Square Comparisons

Non-Investigative girls versus Non-Investigative boys $\chi^2 = 7.81$ $p < .05$

* Does not total 100 percent due to rounding.

Table 70

Distribution in Percents of Responses to "Mathematics Teaches Logical Thinking" as a Reason for Studying Mathematics Beyond Algebra I, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	15	26.7	40.0	33.3
		no	7	0.0	28.6	71.4
	School System	yes	19	10.5	52.6	36.8 *
		no	14	7.1	57.1	35.7 *
	Talent Search	yes	23	21.7	43.5	34.8
		no	20	25.0	35.0	40.0
	Total	yes	57	19.3	45.6	35.1
		no	41	14.6	41.5	43.9
Boys	School System	yes	63	9.5	23.8	66.7
		no	28	10.7	39.3	50.0
	Talent Search	yes	33	9.1	48.5	42.4
		no	14	7.1	64.3	28.6
	Total	yes	96	9.4	32.3	58.3
		no	42	9.5	47.6	42.9

Significant Chi-Square Comparisons

Investigative girls versus Investigative boys $\chi^2 = 8.29$ $p < .05$

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* Does not total 100 percent due to rounding.

with non-investigative career goals as shown in Table 71 . This

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Insert Table 71

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difference reached statistical significance in the comparisons for the total group of boys and the School System boys.

Career Interest and Reasons To Work

On four of the five reasons to work, differences were found between the boys who had investigative career goals and those who had non-investigative career goals. There were no significant differences in response distributions to "feeling an obligation to myself" to work for any of the groups, nor were there any significant differences in response distributions on any of the reasons to work for any of the groups of girls in the study. A detailed discussion of significant differences follows.

Society Will Expect Me To Work

Significant differences were found between the boys from the Talent Search reporting investigative career choices and those reporting non-investigative career choices as shown in Table 72.

Insert Table 72

Table 71

Distribution in Percents of Responses to "Mathematics is Interesting to Study" as a Reason for Studying Mathematics Beyond Algebra I, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	6.7	46.7	46.7	*
		no	7	14.3	42.9	42.9	*
	School System	yes	19	10.9	36.8	52.6	*
		no	14	14.3	57.1	28.6	
	Talent Search	yes	23	8.7	30.4	60.9	
		no	19	15.8	42.1	42.1	
	Total	yes	57	8.8	36.8	54.4	
		no	40	15.0	47.5	37.5	
Boys	School System	yes	62	6.5	38.7	54.8	
		no	28	25.0	46.4	28.6	
	Talent Search	yes	33	9.1	33.3	57.6	
		no	14	21.4	42.9	35.7	
	Total	yes	95	7.4	36.8	55.8	
		no	42	23.8	45.2	31.0	

Significant Chi-Square Comparisons

School System boys	$\chi^2 = 8.56$	$p < .05$
Total boys	$\chi^2 = 10.59$	$p < .01$

* Does not total 100 percent due to rounding.

Table 72

Distribution in Percents of Responses to "Society and Family Will Expect Me to Work" as a Reason to Work, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	15	46.7	46.7	6.7 *
		no	7	71.4	28.6	0.0
	School System	yes	19	26.3	68.4	5.3
		no	14	50.0	50.0	0.0
	Talent Search	yes	23	26.1	65.2	8.7
		no	20	25.0	50.0	25.0
	Total	yes	57	31.6	61.4	7.0
		no	41	41.5	46.3	12.2
Boys	School System	yes	63	23.8	52.4	23.8
		no	28	28.6	50.0	21.4
	Talent Search	yes	33	21.2	69.7	9.1
		no	14	0.0	64.3	35.7
	Total	yes	96	22.9	58.3	18.8
		no	42	19.0	54.8	26.2

Significant Chi-Square Comparisons

Talent Search boys $\chi^2 = 7.11$ $p < .05$

* Does not total 100 percent due to rounding.

Those with investigative career choices were more likely to see society's expectations as "not important" than the non-investigative Talent Search boys, none of whom checked the "not important" category. The non-investigative Talent Search boys reported that society's expectations are "very important" more than did the investigative Talent Search boys. No other comparisons were significant.

Financial Necessity

Boys who reported an investigative career choice were more likely than boys with other career interests to rate the fact that it will be financially necessary for them to work as "very important" as shown in Table 73 . They also were less likely to see it as

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Insert Table 73

"not important."

The non-investigative boys differed significantly from the non-investigative girls as well. No girl with non-investigative career interests saw the financial necessity of working as "not important" while some of the boys chose that response. More of the girls chose "somewhat important" than the boys while more of the boys chose "very important" than did the girls.

Obligation To Society

Boys who had investigative career interests were less likely to feel their obligation to society was "very important" than boys with other career interests as shown in Table 74 . This was true

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Insert Table 74

Table 73

Distribution in Percents of Responses to "Financially Necessary to Work" as a Reason to Work, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	6.7	20.0	73.3	
		no	7	0.0	71.4	28.6	
	School System	yes	19	5.3	31.6	63.2	*
		no	14	0.0	35.7	64.3	
	Talent Search	yes	23	4.3	21.7	73.9	*
		no	20	0.0	40.0	60.0	
	Total	yes	57	5.3	24.6	70.2	*
		no	41	0.0	43.9	56.1	
Boys	School System	yes	63	1.6	19.0	79.4	
		no	28	10.7	17.9	71.4	
	Talent Search	yes	33	0.0	18.2	81.8	
		no	14	7.1	28.6	64.3	
	Total	yes	96	1.0	18.8	80.2	
		no	42	9.5	21.4	69.0	*

Significant Chi-Square Comparisons

Total boys $\chi^2 = 6.38$ $p < .05$

Non-Investigative girls versus Non-Investigative boys $\chi^2 = 7.68$ $p < .05$

* Does not total 100 percent due to rounding.

Table 74

Distribution in Percents of Responses to "Obligation to Society" as a Reason to Work, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	6.7	60.0	33.3	
		no	7	14.3	42.9	42.9	*
	School System	yes	19	5.3	36.8	57.9	
		no	14	21.4	42.9	35.7	
	Talent Search	yes	23	21.7	47.8	30.4	*
		no	20	10.0	65.0	25.0	
	Total	yes	57	12.3	47.4	40.4	*
		no	41	14.6	53.7	31.7	
Boys	School System	yes	63	30.2	47.6	22.2	
		no	28	32.1	35.7	32.1	*
	Talent Search	yes	33	18.2	63.6	18.2	
		no	14	14.3	28.6	57.1	
	Total	yes	96	26.0	53.1	20.8	*
		no	42	26.2	33.3	40.5	

Significant Chi-Square Comparisons

Talent Search boys	$\chi^2 = 7.37$	$p < .05$
Total boys	$\chi^2 = 6.63$	$p < .05$
Investigative boys versus Investigative girls	$\chi^2 = 8.32$	$p < .05$

* Does not total 100 percent due to rounding.

within the Talent Search boys as well.

Sex differences were found between the girls and boys with investigative career interests within the girls' pattern more closely resembling the boys with other than investigative career interests. No other differences were found.

Bored

Boys in School System classes with investigative career interests differed from those with other career interests on "I would be bored if I did not work" as a reason to work as shown in Table 75 . The distribution of responses shows that more

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Insert Table 75

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investigative boys see this as a "very important" reason to work while more non-investigative School System boys see it as "not important".

Sex differences were found between the boys and girls with non-investigative career interests. The girls see fear of boredom as "very important" more than the boys do and the boys respond "not important" more often than do the girls. No other differences were found on this question.

Table 75

Distribution in Percents of Responses to "I would probably be bored if I did not work" as a Reason to Work, by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	15	13.3	33.3	53.3 *
		no	7	14.3	57.1	28.6
	School System	yes	19	10.5	47.4	42.1
		no	14	7.1	42.9	50.0
	Talent Search	yes	23	26.1	26.1	47.8
		no	20	10.0	25.0	65.0
	Total	yes	57	17.5	35.1	47.4
		no	41	9.8	36.6	53.7 *
Boys	School System	yes	63	20.6	44.4	34.9 *
		no	28	46.4	39.3	14.3
	Talent Search	yes	33	15.2	45.5	39.4 *
		no	14	7.1	28.6	64.3
	Total	yes	96	18.8	44.8	36.5 *
		no	42	33.3	35.7	31.0

Significant Chi-Square Comparisons

School System boys $\chi^2 = 7.52$ $p < .05$

Non-Investigative girls versus Non-Investigative boys $\chi^2 = 7.86$ $p < .05$

* Does not total 100 percent due to rounding.

Career Interest and Factors in Job Selection

Differences were found between students who had investigative career goals and those who had non-investigative goals on seven of the thirteen factors in selection of job or career. There were no significant differences on the "cost of education needed," "belief that I will be able to do the job well," "having a position that will be looked up to by others," "possibility of a flexible time schedule," "challenge of difficult work," and "many job openings in the field". Sex differences were found between investigative girls and boys on "opportunities to be helpful to others or useful to society" as a factor in job selection and between boys and girls with other than investigative interests on "opportunities to use my special abilities to the fullest". A detailed discussion of the significant differences follow.

Amount of Mathematics Needed

School System girls with an investigative career choice differed from those with other career interests on the amount of mathematics needed as a factor in job selection as shown in Table 76.

Insert Table 76

Fifty percent of those with non-investigative career interests saw this as "not important" while only 10% of the girls with investigative career interests checked that category. Since those girls have

Table 76

Distribution in Percents of Responses to "Amount of Mathematics Needed" as a Factor in Job Selection by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	26.7	40.0	33.3	
		no	7	42.9	57.1	0.0	
	School System	yes	19	10.5	42.1	47.4	
		no	14	50.0	14.3	35.7	
	Talent Search	yes	23	8.7	39.1	52.2	
		no	20	10.0	60.0	30.0	
	Total	yes	57	14.0	40.4	45.6	
		no	41	29.3	43.9	26.8	
Boys	School System	yes	61	11.5	36.1	52.5	*
		no	28	21.4	46.4	32.1	*
	Talent Search	yes	33	18.2	39.4	42.4	
		no	14	42.9	35.7	21.4	
	Total	yes	94	13.8	37.2	48.9	*
		no	42	28.6	42.9	28.6	*

Significant Chi-Square Comparisons

School System Girls $\chi^2 = 6.92$ $p < .05$

Total Boys $\chi^2 = 6.49$ $p < .05$

* Does not total 100 percent due to rounding.

presumably chosen non-mathematical careers, this is not surprising but it may be a contributory factor to their dropping out of the high school mathematics sequence early.

Differences were also found between the boys choosing an investigative career and those choosing other careers on this factor. The pattern is similar to the one for School System girls, although more of the boys with other than investigative career interests checked the "somewhat important" category than "not important". The boys with investigative career choices chose "very important" most often.

Amount of Education Needed

Girls in School System classes with an investigative career interest differed from those with other interests on amount of education needed as a factor in job selection as shown in Table 77.

Insert Table 77

Most of these girls with investigative career interests see the amount of education needed as very important while the girls with other interests see it as only "somewhat important". No other comparisons were significant.

Table 77

Distribution in Percents of Responses to "Amount of Education Needed" as a Factor in Job Selection by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	6.7	46.7	46.7	*
		no	7	28.6	42.9	28.6	*
	School System	yes	19	0.0	21.1	78.9	
		no	14	7.1	57.1	35.7	*
	Talent Search	yes	23	4.3	30.4	65.2	*
		no	20	5.0	20.0	75.0	
	Total	yes	57	3.5	31.6	64.9	
		no	41	9.8	36.6	53.7	
Boys	School System	yes	61	4.9	34.4	60.7	
		no	28	10.7	21.4	67.9	
	Talent Search	yes	33	15.2	33.3	51.5	
		no	14	14.3	28.6	57.1	
	Total	yes	94	8.5	34.0	57.4	
		no	42	11.9	23.8	64.3	

Significant Chi-Square Comparisons

School System Girls $\chi^2 = 6.73$ $p < .05$

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* Does not total 100 percent due to rounding.

Belief That I Will Enjoy The Job

"Belief that I Will Enjoy the Job" was said to be a "very important" factor in job selection by more School System boys with an investigative career choice than by those with other career interests as shown in Table 78 . No other comparisons were significant.

Insert Table 78

Opportunity To Use My Special Abilities to The Fullest

Girls and boys with non-investigative career interests differed on the question concerning their opportunities to use their special abilities to the fullest as a factor in job selection as shown in Table 79 . More girls saw this as "very important" than the boys.

Insert Table 79

Seven percent of the boys saw this as "not important" while none of the girls did. No other comparisons were significant.

Opportunity To Earn a High Salary

The opportunity to earn a high salary was seen by the Talent Search boys who did not choose investigative careers as "very important" more often than the Talent Search boys who chose an in-

Table 78

Distribution in Percents of Responses to "Belief that I will Enjoy the Job" as a Factor in Job Selection by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	15	0.0	6.7	93.3
		no	7	0.0	14.3	85.7
	School System	yes	19	0.0	15.8	84.2
		no	14	0.0	0.0	100.0
	Talent Search	yes	23	0.0	8.7	91.3
		no	20	0.0	5.0	95.0
	Total	yes	57	0.0	10.5	89.5
		no	41	0.0	4.9	95.1
Boys	School System	yes	62	0.0	3.2	96.8
		no	28	0.0	17.9	82.1
	Talent Search	yes	33	0.0	3.0	97.0
		no	14	0.0	0.0	100.0
	Total	yes	95	0.0	3.2	96.8
		no	42	0.0	11.9	88.1

Significant Chi-Square Comparisons

School System Boys $\chi^2 = 3.90$ $p < .05$

Table 79

Distribution in Percents of Responses to "Opportunity to Use my Special Abilities to the Fullest" as a Factor in Job Selection by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	0.0	33.3	66.7	
		no	7	0.0	0.0	100.0	
	School System	yes	19	0.0	15.8	84.2	
		no	14	0.0	14.3	85.7	
	Talent Search	yes	23	0.0	30.4	69.6	
		no	20	0.0	20.0	80.0	
	Total	yes	57	0.0	26.3	73.7	
		no	41	0.0	14.6	85.4	
Boys	School System	yes	62	3.2	29.0	67.7	*
		no	28	10.7	32.1	57.1	*
	Talent Search	yes	33	0.0	27.3	72.7	
		no	14	0.0	35.7	64.3	
	Total	yes	95	2.1	28.4	69.5	
		no	42	7.1	33.3	59.5	*

Significant Chi-Square Comparisons

Non-investigative girls versus non-investigative boys $\chi^2 = 7.86$ $p < .05$

* Does not total 100 percent due to rounding.

vestigative career choice as shown in Table 80. No other

Insert Table 80

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significant differences were found on this question.

Opportunities to be Helpful To Others or Useful to Society

Sex differences were found between girls and boys with investigative career interests on the importance of "opportunities to be helpful to others or useful to society" as a factor in job selection as shown in Table 81.

Insert Table 81

More of the girls see it as a "very important" factor in their future job choice while the boys see it as only "somewhat important" as shown in Table 81. In addition more boys rate it as "not important" than do the girls.

Chance To Work With People Rather Than Things

Boys with non-investigative career interests see the chance to work with people rather than things as "very important" much more than do boys with investigative interests who choose "somewhat important"

Table 80

Distribution in Percents of Responses to "Opportunity to Earn a High Salary" as a Factor in Job Selection by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	13.3	60.0	26.7	
		no	7	14.3	42.9	42.9	*
	School System	yes	19	10.5	57.9	31.6	
		no	14	28.6	28.6	42.9	*
	Talent Search	yes	23	8.7	52.2	39.1	
		no	20	10.0	50.0	40.0	
	Total	yes	57	10.5	56.1	33.3	*
		no	41	17.1	41.5	41.5	*
Boys	School System	yes	62	8.1	45.2	46.8	*
		no	28	7.1	39.3	53.6	
	Talent Search	yes	33	0.0	69.7	30.3	
		no	14	7.1	35.7	57.1	*
	Total	yes	95	5.3	53.7	41.1	*
		no	42	7.1	38.1	54.8	

Significant Chi-Square Comparisons

Talent Search Boys $\chi^2 = 6.11$ $p < .05$

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* Does not total 100 percent due to rounding.

Table 81

Distribution in Percents of Responses to
"Opportunities to be Helpful to Others or Useful to Society"
as a Factor in Job Selection
by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	13.3	33.3	53.3	*
		no	7	14.3	28.6	57.1	
	School System	yes	19	0.0	42.1	57.9	
		no	14	0.0	35.7	64.3	
	Talent Search	yes	23	8.7	39.1	52.2	
		no	20	10.0	50.0	40.0	
	Total	yes	57	7.0	38.6	54.4	
		no	41	7.3	41.5	51.2	
Boys	School System	yes	62	14.5	54.8	30.6	*
		no	28	10.7	35.7	53.6	
	Talent Search	yes	33	12.1	48.5	39.4	
		no	14	7.1	50.0	42.9	
	Total	yes	95	13.7	52.6	33.7	
		no	42	9.5	40.5	50.0	

Significant Chi-Square Comparisons

Investigative girls versus investigative boys $\chi^2 = 6.58$ $p < .05$

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* Does not total 100 percent due to rounding.

and "not important" with greater frequency as shown in Table 82.

Insert Table 82

This pattern is true for the School System boys as well. No other differences were found on this question.

Table 82

Distribution in Percents of Responses to "Chance to Work with People Rather than Things" as a Factor in Job Selection by Sex, Group, and Investigative Career Choice

Sex	Group and Investigative Career Choice		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	15	26.7	46.7	26.7	*
		no	7	28.6	14.3	57.1	
	School System	yes	18	22.2	50.0	27.8	
		no	14	14.3	57.1	28.6	
	Talent Search	yes	23	30.4	43.5	26.1	
		no	20	14.5	45.0	40.0	
	Total	yes	56	26.8	46.4	26.8	
		no	41	17.1	43.9	39.0	
Boys	School System	yes	62	30.6	56.5	12.9	
		no	28	21.4	39.3	39.3	
	Talent Search	yes	33	51.5	27.3	21.2	
		no	14	28.6	28.6	42.9	*
	Total	yes	95	37.9	46.3	15.8	
		no	42	23.8	35.7	40.5	

Significant Chi-Square Comparisons

School System boys $X^2 = 8.06$ $p < .05$

Total boys $X^2 = 10.08$ $p < .01$

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* Does not total 100 percent due to rounding.

THE RELATIONSHIPS BETWEEN ACCELERATION STATUS AND ATTITUDES

Since all students who participated in a special class were not accelerating their progress in mathematics and some students in the comparison groups were accelerating, it seemed likely that accelerated and non-accelerated would differ with respect to some attitudes and interests. Therefore, an analysis was made of student responses within and across treatment groups to determine in what ways accelerated and non-accelerated students were alike and different in their responses to the questionnaire items.

Acceleration and Reasons to Study Mathematics

Responses of accelerated and non-accelerated students to reasons to study mathematics beyond Algebra I were examined. There were no significant differences in response patterns for five of the seven reasons within the groups or between the sexes. Some significant differences were found in response to the importance of studying mathematics because it is interesting to learn and easy to learn as discussed in the following sections.

Interesting

Accelerated boys were more likely than non-accelerated boys to rate "mathematics is interesting to study" as a "very important" reason for studying mathematics (46.7% vs. 37.9%) as shown in Table 83 . This difference was statistically significant

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Insert Table 83

Table 83

Distribution Percents of Responses to "Mathematics is interesting to study" as a Reason for Studying Mathematics Beyond Algebra I, by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	12.5	50.0	37.5
		no	14	7.1	42.9	50.0
	School System	yes	27	7.4	40.7	51.9
		no	5	40.0	60.0	0.0
	Talent Search	yes	17	11.8	29.4	58.8
		no	26	11.5	38.5	50.0
	Total	yes	52	9.6	38.5	51.9
		no	45	13.3	42.2	44.4 *
Boys	School System	yes	79	15.2	43.0	41.8
		no	10	20.0	40.0	40.0
	Talent Search	yes	28	0.0	39.3	60.7
		no	19	31.6	31.6	36.8
	Total	yes	107	11.2	42.1	46.7
		no	29	27.6	34.5	37.9

Significant Chi-Square Comparisons

School System Girls	$\chi^2 = 6.54$, $p < .05$
Talent Search Boys	$\chi^2 = 10.29$, $p < .01$

* Does not add up to 100 due to rounding

within the group of Talent Search boys in which the number of accelerates and non-accelerates were more nearly equal. The overall relationship of acceleration to the rating of the importance of "mathematics is interesting" as a reason to study mathematics beyond Algebra was not found for girls, except within the School System group. In that group no girl who had participated in the School system program but was not accelerated thought "mathematics is interesting" was a reason to study mathematics. One must suspect that because these girls did find mathematics highly interesting they were not accelerating, and had dropped out of the special program.

Easy

Almost a third of the non-accelerated boys (31%), but only 17.6% of the accelerated boys rated "mathematics is easy" as a "very important" reason for studying mathematics as shown in Table 84.

Insert Table 84

This was not statistically significant but within the Talent Search group there was a statistically significant difference in the distribution of responses for accelerated and non-accelerated boys. A larger proportion of non-accelerates than accelerates rated this factor as "not important" or "very important" while the accelerates were likely to rate this as "somewhat important". Non-accelerated boys in general were more likely than non-accelerated girls to rate mathematics is easy" as "very importnat".

Table 84

Distribution in Percents of Responses to "Mathematics is Easy to Learn" as a Reason for Studying Mathematics Beyond Algebra I, by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	8	25.0	75.0	0.0	
		no	14	42.9	42.9	14.3	*
	School System	yes	27	33.3	51.9	14.8	
		no	5	80.0	20.0	0.0	
	Talent Search	yes	17	35.3	47.1	17.6	
		no	26	38.5	53.8	7.7	
	Total	yes	52	32.7	53.8	13.5	
		no	45	44.4	46.7	8.9	
Boys	School System	yes	80	46.3	36.3	17.5	*
		no	10	10.0	50.0	40.0	
	Talent Search	yes	28	32.1	50.0	17.9	
		no	19	63.2	10.5	26.3	
	Total	yes	108	42.6	39.8	17.6	
		no	29	44.8	24.1	31.0	*

Significant Chi-Square Comparisons

Talent Search boys $\chi^2 = 8.00$ $p < .05$

Non-accelerated girls versus Non-accelerated boys $\chi^2 = 7.29$ $p < .05$

* Does not total 100 percent due to rounding.

Acceleration and Reasons to Work

Responses of accelerated students and non-accelerated students to the importance of five reasons to work were examined. There were no significant differences between accelerated and non-accelerated students as a whole or within any subgroup in responses to the importance of "obligation to self" or "I would probably be bored if I did not work." Sex differences among accelerated students and among non-accelerates were not found on these questions. Some significant differences were found in response patterns for the remaining three reasons and they are discussed in the following sections.

Society and Family Expect

Responses to this question were not significantly different for accelerated and non-accelerated girls as a whole or within the subgroups as shown in Table 85 . For boys, however, significant differences were found. Accelerated boys were more likely than non-accelerates to say this was a "very important" or a "not very important" reason. About eighty percent of the non-accelerated boys said it was "somewhat important." Among the Talent Search boys, accelerates were more likely to say "not important" than non-accelerates (25 percent, as compared to zero percent). Accelerated boys were more likely than accelerated girls to rate this as "very important", whereas non-accelerated girls rated this as "not very important" more often than did non-accelerated boys.

Insert Table 85

Table 85

Distribution in Percents of Responses to "Society and Family Will Expect Me to Work" as a Reason to Work by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important			
				Not	Somewhat	Very	
Girls	Career	yes	8	75.0	25.0	0.0	
		no	14	42.9	50.0	7.1	
	School System	yes	27	33.3	63.0	3.7	
		no	5	60.0	40.0	0.0	
	Talent Search	yes	18	27.8	55.6	16.7	*
		no	26	23.1	61.5	15.4	
	Total	yes	53	37.7	54.7	7.5	*
		no	45	33.3	55.6	11.1	
Boys	School System	yes	80	21.3	53.8	25.0	*
		no	10	10.0	70.0	20.0	
	Talent Search	yes	28	25.0	57.1	17.9	
		no	19	0.0	84.2	15.8	
	Total	yes	108	22.2	54.6	23.1	*
		no	29	3.4	79.3	17.2	*

Significant Chi-Square Comparisons

Total boys $\chi^2 = 7.11$ $p < .05$

Talent Search boys $\chi^2 = 6.00$ $p < .05$

Accelerated girls versus accelerated boys $\chi^2 = 7.94$ $p < .05$

Non-accelerated girls versus non-accelerated boys $\chi^2 = 9.31$ $p < .01$

* Does not total 100 percent due to rounding.

Financially Necessary

The responses to the importance of financial necessity were not significantly different for accelerates and non-accelerates within the same sex groups as shown in Table 86 . Boys, however, were more likely to rate this as "very important" than were the girls and this difference was statistically significant in the comparison of accelerated boys and girls.

Insert Table 86

Obligation to Society

Accelerated and non-accelerated girls as a total group were very similar in responses to the importance of an "obligation to society" but within the career class the differences were striking and significant as shown in Table 87 . No accelerated girl rated this as a very important reason, but over half (57.1 percent) of the non-accelerates said this was a "very important" reason. Overall, more non-accelerated boys than accelerated ones checked this reason as "very important", and this difference was statistically significant within the Talent Search group.

Insert Table 87

Table 86

Distribution in Percents of Responses to "Financially Necessary to Work" as a Reason to Work, by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	0.0	37.5	62.5
		no	14	7.1	35.7	57.1 *
	School System	yes	27	7.4	40.7	51.9
		no	5	0.0	0.0	100.0
	Talent Search	yes	18	5.6	38.9	55.6 *
		no	26	0.0	23.1	76.9
	Total	yes	53	3.8	28.3	67.9
		no	45	2.2	28.9	68.9
Boys	School System	yes	80	1.3	21.3	77.5 *
		no	10	10.0	0.0	90.0
	Talent Search	yes	28	3.6	21.4	75.0
		no	19	0.0	21.1	78.9
	Total	yes	108	1.9	21.3	76.9 *
		no	29	3.4	13.8	82.8

Significant Chi-Square Comparisons

Accelerated girls versus accelerated boys $\chi^2 = 8.53$ $p < .05$

* Does not total 100 percent due to rounding.

Table 87

Distribution in Percents of Responses to "Obligation to Society" as a Reason to Work, by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	25.0	75.0	0.0
		no	14	0.0	42.9	57.1
	School System	yes	27	11.1	44.4	44.4 *
		no	5	20.0	60.0	20.0
	Talent Search	yes	18	16.7	44.4	38.9
		no	26	15.4	61.5	23.1
	Total	yes	53	15.1	49.1	35.8
		no	45	11.1	55.6	33.3
Boys	School System	yes	80	30.0	45.0	25.0
		no	10	20.0	60.0	20.0
	Talent Search	yes	28	21.4	64.3	14.3
		no	19	10.5	36.8	52.6 *
	Total	yes	108	27.8	50.0	22.2
		no	29	13.8	44.8	41.4

Significant Chi-Square Comparisons

Career Class	$\chi^2 = 9.04$	$p < .05$
Talent Search boys	$\chi^2 = 7.98$	$p < .05$

* Does not total 100 percent due to rounding.

Acceleration and Factors Influencing Job Selection

In general, there were few significant differences between accelerated and non-accelerated students in their ratings of factors influencing job-selection. Of the thirteen factors evaluated, response patterns were significantly different on only five factors for one or more comparison groups. These factors are discussed in the following sections.

Amount of Mathematics

Non-accelerated boys were more likely than accelerated boys to view the amount of mathematics required for the job as a "not important" factor in selecting a job as shown in Table 88 . This was not true for girls.

Insert Table 88

Cost of Education

Accelerated girls were significantly more likely than non-accelerated girls to say that the cost of the education needed for a job was not an important consideration in selecting the job as shown in Table 89 . This relationship was strongest within the Talent Search group.

Insert Table 89

Table 88

Distribution in Percents of Responses to Amount of Mathematics as a Factor Influencing Job Selection by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	12.5	50.0	37.5
		no	14	42.9	42.9	14.3 *
	School System	yes	27	25.9	33.3	40.7 *
		no	5	40.0	20.0	40.0
	Talent Search	yes	18	16.7	50.0	33.3
		no	26	3.8	46.2	50.0
	Total	yes	53	20.8	41.5	37.7
		no	45	20.0	42.2	37.8
Boys	School System	yes	78	14.1	44.9	41.0
		no	10	20.0	20.0	60.0
	Talent Search	yes	28	14.3	42.9	42.9 *
		no	19	42.1	31.6	26.3
	Total	yes	106	14.2	44.3	41.5
		no	29	34.5	27.6	37.9

Significant Chi-Square Comparisons

Total Boys $\chi^2 = 6.72$ $p < .05$

* Does not total 100 percent due to rounding.

Table 89

Distribution in Percents of Responses to Cost of Education as a Factor Influencing Job Selection by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	37.5	50.0	12.5
		no	14	35.7	28.6	35.7
	School System	yes	27	25.9	66.7	7.4
		no	5	20.0	60.0	20.0
	Talent Search	yes	18	50.0	27.8	22.2
		no	26	7.7	53.8	38.5
	Total	yes	53	35.8	50.9	13.2 *
		no	45	17.8	46.7	35.6 *
Boys	School System	yes	79	30.4	46.8	22.8
		no	10	10.0	50.0	40.0
	Talent Search	yes	28	28.6	50.0	21.4
		no	19	31.6	52.6	15.8
	Total	yes	107	29.9	47.7	22.4
		no	29	24.1	51.7	24.1 *

Significant Chi-Square Comparisons

Talent Search Girls $\chi^2 = 10.17$ $p < .01$

Total Girls $\chi^2 = 8.15$ $p < .05$

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* Does not total 100 percent due to rounding.

Do the Job Well

The belief in one's ability to do the job well as a factor in job selection was not rated significantly different for accelerated and non-accelerated boys as shown in Table 90 . More than three-

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Insert Table 90

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quarters of all the boys thought this was a very important factor. Overall, girls (85.7 percent) thought this was a very important factor, and the difference between accelerated and non-accelerated girls was not significant although there was a slight trend for non-accelerated girls to see this as more important. This trend was significant within the Talent Search group, where 100 percent of the non-accelerates rated this as "very important" as compared with 72.2 percent of the accelerates.

High Salary

The importance of a high salary to job selection as shown in Table 91 did not differ for accelerated and non-accelerated

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Insert Table 91

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students, except within the group of School System girls, in which 80 percent of the non-accelerates rated this as "very important", whereas only 25.9 percent of the accelerated School System girls rated this as "very important". The number of non-accelerated girls in this group is very small, however, and this result does not reflect a general trend for the girls as a whole.

Table 90

Distribution in Percents of Responses to Ability to do the Job Well as a Factor Influencing Job Selection by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	0.0	12.5	87.5
		no	14	0.0	14.3	85.7
	School System	yes	27	0.0	18.5	81.5
		no	5	0.0	20.0	80.0
	Talent Search	yes	18	0.0	27.8	72.2
		no	26	0.0	0.0	100.0
	Total	yes	53	0.0	20.8	79.2
		no	45	0.0	6.7	93.3
Boys	School System	yes	78	7.7	14.1	78.2
		no	10	0.0	10.0	90.0
	Talent Search	yes	28	0.0	28.6	71.4
		no	19	0.0	21.1	78.9
	Total	yes	106	5.7	17.9	76.4
		no	29	0.0	17.2	82.8

Significant Chi-Square Comparisons

Talent Search Girls $\chi^2 = 5.62$ $p < .05$

Table 91

Distribution in Percents of Responses to High Salary as a Factor Influencing Job Selection by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	0.0	50.0	50.0
		no	14	21.4	57.1	21.4 *
	School System	yes	27	11.1	63.0	25.9
		no	5	20.0	0.0	80.0
	Talent Search	yes	18	16.7	44.4	38.9
		no	26	3.8	57.7	38.5
	Total	yes	53	11.3	54.7	34.0
		no	45	11.1	51.1	37.8
Boys	School System	yes	79	7.6	43.0	49.4
		no	10	0.0	40.0	60.0
	Talent Search	yes	28	3.6	64.3	32.1
		no	19	0.0	52.6	47.4
	Total	yes	107	6.5	48.6	44.9
		no	29	0.0	48.3	51.7

Significant Chi-Square Comparisons

School System Girls $\chi^2 = 7.00$ $p < .05$

* Does not total 100 percent due to rounding.

Job Openings

Almost half (46.7 percent) of the non-accelerated girls, but only a fifth (20.8 percent) of the accelerated girls, believed that the fact that there were many job openings in the field was a "very important" factor in selecting a job as shown in Table 92 . A third of the boys, accelerated or non-accelerated, believed this was a "very important" factor. Thus, accelerated girls were more like boys than were the non-accelerated girls on this factor, but acceleration was not related to differences among boys.

Insert Table 92

Acceleration and Investigative Career Interest and Life-Style Plan

Students who were accelerated were compared with non-accelerated students on their first choice for a future career as categorized into investigative or non-investigative choices. Career and life-style plans were also examined. The results of the analyses are presented in the following sections.

Investigative Career Interest

Forty-nine of the 77 girls who had investigative interests were accelerated (64%) but only 24 (48%) of the 50 girls who had other career interests were accelerated. About 80 percent (107) of

Table 92

Distribution in Percents of Responses to Many Job Openings as a Factor Influencing Job Selection by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Important		
				Not	Somewhat	Very
Girls	Career	yes	8	0.0	75.0	25.0
		no	14	14.3	64.3	21.4
	School System	yes	27	14.8	74.1	11.1
		no	5	20.0	20.0	60.0
	Talent Search	yes	18	16.7	50.0	33.3
		no	26	3.8	38.5	57.7
	Total	yes	53	13.2	66.0	20.8
		no	45	8.9	44.4	46.7
Boys	School System	yes	79	15.2	50.6	34.2
		no	10	10.0	50.0	40.0
	Talent Search	yes	28	14.3	53.6	32.1
		no	19	21.1	47.4	31.6 *
	Total	yes	107	15.0	51.4	33.6
		no	29	17.2	48.3	34.5

Significant Chi-Square Comparisons

School System Girls	$\chi^2 = 7.33$	$p < .05$
Total Girls	$\chi^2 = 7.43$	$p < .05$

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* Does not total 100 percent due to rounding.

the 134 boys who had investigative interests were accelerated whereas about 70 percent (38) of the 56 boys who had other career interests were accelerated. Or as shown in Table 93 about two-thirds

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Insert Table 93

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of the accelerated girls are considering careers of an investigative type but only about half of the non-accelerated girls prefer investigative careers. The chi-square comparisons, however, were not statistically significant.

Career and Life-Style Plan

Forty-seven of the 101 girls in the study said they would prefer a full-time career always with or without marriage and children. Of these 47 the majority (66 percent) were accelerated. Only two of the 14 girls who choose a traditional, non-career life-style were accelerated. Or, one could ask: Do girls who accelerate have different life-style plans than those who don't. Girls who are accelerated were more likely to prefer a full-time career life-style than a part-time career while raising children or no career after marriage or children. Over half of the accelerated girls chose full-time career and slightly over a third (37.7 percent) chose a part-time career, while only 3.8 percent chose no career. Non-accelerated girls were more likely to prefer the part-time career life-style than the other alternatives. Only a third of these girls (33.3 percent) chose a full-time career and 41.7 percent chose a part-time career, and a fourth (25 percent) chose no career. Thus, there

Table 93

Distribution in Percents of Responses to Career and Life Style Plan for Self by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Career Plan		
				Full Time	Full/Parttime Combination	Limited
Girls	Career	yes	8	75.0	25.0	0
		no	14	28.6	64.3	7.1
	School System	yes	27	44.4	48.1	7.4 *
		no	8	62.5	37.5	0
	Talent Search	yes	18	72.2	27.8	0
		no	26	26.9	30.8	42.3
	Total	yes	53	58.5	37.7	3.8
		no	48	33.3	41.7	25.0
Boys	School System	yes	78	94.9	5.1	0
		no	18	100.0	0	0
	Talent Search	yes	27	100.0	0	0
		no	19	94.7	5.3	0
	Total	yes	105	96.2	3.8	0
		no	37	97.3	2.7	0

Significant Chi-Square Comparisons

Talent Search Girls	$\chi^2 = 8.95$	$p < .05$
Total Girls	$\chi^2 = 11.71$	$p < .01$
Accelerated Girls versus Accelerated Boys	$\chi^2 = 36.64$	$p < .001$
Non-Accelerated Girls vs. Non-Accelerated Boys	$\chi^2 = 36.00$	$p < .001$

* Does not total 100 percent due to rounding.

appears to be a significant relationship between acceleration and life-style plans. The chi-square tests of significance for the distributions of responses by group and sex are shown in Table 94.

Insert Table 94

It seems unlikely that acceleration in mathematics influences life-style choice per se, but life-style choice may indirectly affect willingness to accelerate. Girls who have strong career goals and a determination to have a full-time career may be more likely to see the value of accelerating their study of mathematics. Support for this interpretation comes from an analysis of the trends within the three treatment groups.

Girls who participated in the career class and those in the 1978 Talent Search who have accelerated their mathematics placement most likely had to do so on their own, sometimes facing opposition and resistance from the schools. Three-fourths of the accelerated girls in the career class and 72.2 percent of the accelerated Talent Search group chose a life-style involving a full-time career, whereas only 28.6 percent of the non-accelerated career class girls and 26.9 percent of the non-accelerated Talent Search girls chose such a life-style. Or, put another way, 60 percent and 65 percent, respectively, of the career and Talent Search girls who preferred a full-time career were accelerated, whereas 18.2 percent and 38.5 percent of those who

Table 94

Distribution in Percents of Students with Investigative or Non-Investigative Career Choices by Sex, Group, and Acceleration Status

Sex	Group and Acceleration Status		Number	Career Plan	
				Investigative	Non-Investigative
Girls	Career	yes	8	62.5	37.5
		no	14	71.4	28.6
	School System	yes	47	70.2	29.8
		no	14	42.9	57.1
	Talent Search	yes	18	61.1	38.9
		no	26	46.2	53.8
	Total	yes	73	67.1	32.9
		no	54	51.9	48.1
Boys	School System	yes	117	72.7	27.3
		no	26	61.5	38.5
	Talent Search	yes	28	78.6	21.4
		no	19	57.9	42.1
	Total	yes	145	73.8	26.3
		no	45	60.0	40.0

Significant Chi-Square Comparisons

None

* Does not total 100 percent due to rounding.

chose part-time career life-styles were accelerated. No girls in those groups who chose no career were accelerated.

The school system accelerates were invited to be in an accelerated program, thus, their acceleration may have required somewhat less personal commitment to moving ahead. In this group, most are accelerated and there is no relationship between life-style choice and acceleration. It is possible that girls who were invited but chose not to participate had more traditional life-style goals; alas, these data were not available.

Chapter V

SUMMARY AND CONCLUSIONS

The intent of this study was to determine the effectiveness of various programs for the mathematically gifted upon the course-taking and attitudes of girls. This section of the report summarized the major findings and their implications for increasing women's participation in advanced mathematics courses.

COURSE-TAKING AND ACCELERATION

In this study the acceleration, course-taking behaviors, and plans of mathematically gifted girls who participated in one of three special programs were compared with those of equally able boys and girls who had no such programs and boys in similar programs. The results are somewhat mixed.

Boys and girls who participated in a mathematics talent search as seventh graders - 1973 and who had no special program differed with respect to course-taking and acceleration by the end of grade eleven. More boys than girls accelerated in their study of mathematics and more boys than girls had completed the pre-calculus sequence. Although the percentage of boys who actually took Calculus in the eleventh or twelfth grade was higher than the percentage of girls, the difference was not statistically significant. Comparison of students' plans who were seventh graders on the 1978 talent search, however, were not significantly different. There are two possible explanations. The first is that in the five years between 1973 and 1978 girls' attitudes have changed. Seventy-three percent of girls in the 1978 talent search plan to take Calculus while only 40 percent of the 1973 talent search group did so. The percentage of 1978 boys who plan to take the Calculus is about the same as the actual percentage of 1973 boys who did so. A second less optimistic view is that the course-taking projections of the 1978 talent search girls are not accurate. It is far more compelling to hope that this data indicates an elimination of sex difference in mathematics course-taking among the current younger group of mathematically able students.

The first treatment to be studied was an accelerated Algebra I class with a career education component for girls only in the summer of 1973. Although these girls were initially accelerated in their mathematics placement by one year, by the end of the eleventh grade they were no longer ahead of the control boys or girls. These girls were no more likely than the control girls and less likely than the control boys to take Calculus.

The second treatment studied was an accelerated program with a public school system. This analysis actually included students in four different school systems. Girls who participated in these programs are significantly more accelerated than girls of similar ability who did not have a program. Although they are not significantly more accelerated than the comparison boys who had no special program they are keeping pace with the boys who participated in the special programs with them. These girls are accelerating their progress more successfully than did the girls in the Hopkins all girl class.

The third treatment was a career class for girls only with no accelerative component. Girls who participated in this program differ in course-taking behavior and plans only in comparison with the girls in the school system accelerated classes who are more accelerated.

ATTRITION AND ACHIEVEMENT IN THE SCHOOL SYSTEM PROGRAMS

If one sums across all classes in the four school systems there were 208 boys and 100 girls who enrolled in the special classes. Of these students 136 boys and 55 girls completed the program through Algebra I, Algebra II and Plane Geometry (which was the sum total of the program in some of the systems). Thus the overall completion rates favored the boys but was not a statistically significant difference. More boys than girls completed the program in seven of the 12 separate classes. The ratio of boys to girls in the class was not systematically related to completion rates of girls.

Boys and girls who completed the special accelerated programs scored very high on The Cooperative Mathematics Series Tests of achievement for Algebra I, Algebra II and Plane Geometry. The mean score for both sexes was a score at the 97th percentile on eighth grade national norms for Algebra I. The girls and boys mean scores for Algebra II were at the 93rd and 95th percentile, respectively. On the Plane Geometry test the girls' and boys' mean scores were at the 97th and 98th percentiles, respectively. There were no significant differences between the sexes in achievement on these three tests. Although ability as measured by the Scholastic Aptitude Test - Mathematics (SAT-M) was not related to completion of the programs, it was significantly correlated with achievement test scores in Algebra I, and Algebra II for both boys and girls. For boys but not girls achievement on the Plane Geometry test was correlated with SAT-M socres. Thus girls who persist in the programs do as well as the boys and girls who do not persist are not less able than those who do. Factors other than ability must account for the differential completion rates in the special programs.

Although data on reasons students did not complete the programs were not systematically collected, anecdotal information suggested two major reasons why some students did not complet the programs. Although the classes were run by School systems, they were system-wide and thus met in the afternoons, evenings, or on Saturdays; some students had problems of transportation or conflicts with extra-curricular activities. If the accelerated classes had been conducted during the regular school day within the home school more boys and girls would have remained in the programs. Indeed some students dropped from the special classes but continued to accelerate their mathematics study by taking advanced courses in a high school. So some students, male and female, failed to complete the program because of logistical problems rather than because they disliked the class or failed to achieve in it. Some students, male and female, dropped out of the courses because they were not enjoying them enough to want to work hard and do the heavy homework assignments.

ATTITUDES

Although course-taking and achievement were the major variables studied, some measures of attitudes were collected. Students in the 1978 Talent Search completed the Fenema-Sherman Mathematics Attitude Scales. These students and students in the treatment groups completed a questionnaire assessing attitudes about reasons for studying mathematics, reasons to work and the importance of various factors in selecting a career. Questions about careers and life-style plans, educational aspirations, and rememberances of the encouragement of significant others were also asked. Comparisons were made between the responses of boys and girls within and across treatment groups as well as between the same sex students in different treatment groups. In addition responses of students who were accelerated in mathematics were compared with those of students who were not accelerated within and across treatment groups.

Sex Differences in Attitudes

Differences between boys and girls in mathematics achievement, particularly with respect to the study of advanced mathematics courses in high school and college, are often assumed to be outgrowths of sex differences in attitudes, interests, and aspirations. Thus in the present study it seemed important to look for similarities and differences in attitudes, interests, and aspirations between mathematically talented boys and girls within and across treatment groups.

Reasons to Study Mathematics

Previous research on sex differences in mathematics has suggested that boys and girls, even the mathematically gifted, differ with respect to the perceived usefulness of the study of mathematics, particularly with respect to its importance for their future career plans. The mathematically gifted boys and girls in the present study, however, were very similar with respect to responses to the question "reasons to study mathematics beyond Algebra I." The largest percentage (two-thirds or more) of both sexes rated "Mathematics will be important for my future career" as "very important". Slightly more than half of both boys and girls thought that "mathematics was required to get into a good college" and "needed in this technological age" were very important reasons. Slightly less than half of both sexes thought that "mathematics is interesting to study" was a very important reason. The statements "mathematics is easy to learn" and "many of my friends will be taking advanced mathematics courses" were not considered to be "very important" by very many girls or boys. Slightly more than half the boys and a little over a third of the girls rated "mathematics teaches logical thinking" as "very important". This difference was not significant within the total group comparisons but did reach significance in comparisons between boys and girls in the accelerated school system programs and in comparisons between boys and girls who indicated investigative career choices. Significant differences were found for only two other subgroup comparisons. Boys who had non-inves- career plans were more likely to say that friends were a somewhat or a very important reason than were girls with non-investigative career interests. Non-accelerated boys were more likely than non-accelerated girls to say that "mathematics is easy to learn" was "very important" as opposed to "somewhat important." Thus in this study boys and girls who are mathematically able differ very little with respect to their reported perceptions of the reasons to study mathematics.

Mathematics as a Male Domain

The Fennema-Sherman Mathematics Attitude Scale (F-S MAS) were administered to boys and girls in the Talent Search group. Boys were significantly more likely then girls to respond agree or undecided to stereotyped assertions. Yet on a questionnaire only six percent of these boys noted that people at their school believe such stereotypes whereas 21 percent of the girls felt such attitudes existed in their schools.

Self-Confidence

Boys in the Talent Search scored higher than the girls on the self-confidence as a learner of mathematics scale of the F-S MAS

Support of Significant Others

When asked who or what did they feel had encouraged the development of interest and ability in mathematics students both male and female were more likely to recall a teacher than a parent. If parents were mentioned, fathers were mentioned more frequently than mothers. This was especially true for boys. When asked at what age this encouragement had first happened boys and girls responded similarly with the majority recalling the events at ages five to twelve.

Reasons to Work

Mathematically talented girls and boys differed most strikingly on responses to questions about reasons to work. Chi-square tests of response distributions were significant for each of the five reasons for the comparisons of total boys and girls. Boys were more likely than girls to say that "society and family expect me to work" and "financially necessary" were very important reasons, whereas girls were more likely than boys to say that they felt an "obligation to self", "obligation to society" or "would be bored" were very important reasons. When asked to indicate the most important reason for working, almost half the boys (49.3 percent) said "financially necessary", while over half the girls (56.9 percent) said "obligation to self."

Subgroup comparisons, however, suggest that sex differences in responses to the reasons to work were moderated by other factors. Girls and boys who had investigative career interests differed on response patterns to "obligation to self" and "obligation to society", but not on the other reasons, whereas girls and boys with non-investigative career interests differed on their responses to "financially necessary" and "would be bored". Thus, one might conclude that boys and girls who have mathematical talent and congruent career interests don't differ very much except that the girls feel more press for "social drives" than the investigative boys. Among non-investigative boys and girls one sees a more traditional male-female difference. These boys feel the press of financial necessity more than the girls, where the girls see possible "boredom" as a more compelling reason. Boys who have not and do not expect to accelerate their mathematics education differ most from their female cohorts. They feel that "society and family expect them to work" is a more compelling reason to work than do non-accelerated girls, but otherwise the two are not different. Accelerated boys and girls are more alike than different with respect to responses to "reasons to work", but the girls are less likely to see both financial necessity and social and family expectations as important as do the boys.

Level of Educational Aspiration

The level of educational aspiration was very high for both boys and girls. About two-thirds of both sexes hoped to attend a graduate or professional school beyond a four year college program and only two percent of the boys and no girls in the School System, Talent Search and Career Class groups expected to obtain less than a college degree. More girls than boys in the Hopkins all-girls' treatment groups aspired to the graduate or professional school while more boys than girls in the Talent Search had such aspirations. Significant sex differences were found only when girls who had participated in a special all girl class which had a career component were compared with the total population of boys or the School System boys.

Factors in Job Selection

Although mathematically talented boys and girls do differ with respect to the perceived importance of various reasons to work, they differ on response patterns to only three of thirteen factors with respect to job selection. These girls seem to be more concerned than their male cohorts about their ability to "do the job well", to "use their abilities to the fullest" and, to a lesser extent, to enjoy the "challenge of difficult work". Within the groups of girls and boys who participated in a school system sponsored accelerated program, there were also differences in the value of "being helpful to others or society." More girls than boys in this group thought this was "very important" and more boys than girls thought it was "not important."

When one compares the response of accelerated boys with those of accelerated girls and the responses of non-accelerated boys with those of non-accelerated girls there are no sex differences with respect to the importance of the thirteen factors in job selection. When one compares the responses of boys and girls who have investigative career interests there is only one significant difference. More of these girls then boys are concerned about being helpful to others or society. A comparison of boys and girls with non-investigative career interests reveals only one significant difference. Girls with non-investigative career interests are more concerned than their male cohorts about having an opportunity to use their special abilities to the fullest.

Investigative Career Choice

Approximately 71 percent of the boys and 61 percent of the girls in the study had career interests which can be described as investigative according to the Holland (1958) system of vocational classification. Slightly more girls than boys expressed interest in careers of a social, conventional, economic, or artistic nature but these differences were not statistically significant.

Career and Life Style Plan

Girls and boys differed markedly in their career and life-style plans for themselves and their spouses. Less than half the girls (47 percent) but about 97 percent of the boys expect to have a full time career always. Many girls (40 percent) want a full time career except while raising small children and only 14 percent have limited career aspirations. Approximately 94 percent of the girls expect their spouses to work full time always where as only 13 percent of the boys expect their wives to have full time careers. Over half the boys (57 percent) expect their wives to work only until they marry and have children or not at all.

Differences in Attitudes Related to Treatment Group

A question of interest in the present study was whether or not boys and girls who participated in special programs would have different attitudes and interests from equally able students who have not participated in a special class. There were very few significant differences in questionnaire responses between students of the same sex who had participated in special classes and those who had not.

Reasons to Study Mathematics

Career class girls did not differ from girls in the School System group or from girls in the Talent Search group with respect to responses to any questions about the reasons to study mathematics beyond Algebra I. Boys who participated in the School System classes responded differently from boys in the Talent Search group on two of the seven questions about reasons to study mathematics. The School System boys were more likely than the Talent Search boys to say that being friends was either "very important" or "not important" as opposed to "somewhat important". These same boys were also more likely than the Talent Search boys to say that "mathematics teaches logical thinking" was a very important reason to study mathematics.

Significant Others

Boys and girls who participated in the School System programs were more likely to recall teachers as having a positive influence then were the Talent Search boys and girls. This trend, however, was not statistically significant.

Reasons to Work

For girls in the study only one comparison related to the five reasons to work was significantly different for treatment groups. Career Class girls said that "society and family expect me to work" was not important more than did the Talent Search girls. For boys one difference was found between the School System and Talent Search groups. Talent Search boys said they would be bored if they did not work was a "very important" reason more often than the School System boys. There were no group differences in the responses to the most important reason to work.

Level of Educational Aspiration

Two all girl classes, the Hopkins accelerated Algebra class and the Career Class had included exposure to female role models, many of whom had attained or were working on MD or PhD degrees. It is thus interesting that the girls in these two groups far exceeded the boys as a whole and all other girls with respect to their level of aspiration. Approximately 86 and 82 percent of these girl groups, respectively, wanted a degree beyond the four year college level.

Factors in Job Selection

Only one treatment group difference was found among the groups of girls on the thirteen factors for selecting a job. Career Class girls said the amount of mathematics needed was "not important" more often than did the Talent Search girls. Talent Search boys said that available job openings were very important more often than did the School System boys. In selecting the most important factor more Career Class girls and School System girls choose "enjoy the job" than did the Talent Search girls and Talent Search boys choose this reason more often than did the School System boys.

Investigative Career Choices

The majority proportion of girls and boys in all the groups in the study had career interests that were classified as investigative. The proportion of girls with an investigative career choice was the smallest (53.5) in the Talent Search group and the largest in the Career Class group (68.2) but the difference was not significant.

Career and Life Style Plan

Girls who participated in either the Career Class or the School System accelerated programs were significantly less likely than the Talent Search girls to project a limited career for themselves, around five percent of the treatment group as compared with 25 percent of the Talent search group. Since self-selection played a role in participation in the special classes, one could speculate that girls with limited career expectations do not elect to participate in special programs; on the other hand, one could speculate that participation in the special programs heightened the girls' commitments to having a career. For boys there were no treatment group differences in response to career and life plans for self.

Acceleration and Attitudes

Not all students who were in the treatment programs actually became accelerated and some "control" students accelerated themselves, therefore, it seemed desirable to compare accelerated and non-accelerated students on measures of attitudes within and across treatment.

Reasons to Study Mathematics

Accelerated boys were more likely than non-accelerated boys to report that "mathematics is interesting" was a very important reason for studying mathematics. Non-accelerates more than accelerates rated "mathematics is easy to learn" as either a very important or a not important reason to study mathematics while accelerates viewed this as a somewhat important reason. For girls there were no differences in responses to questions about studying mathematics between accelerates and non-accelerates.

Significant Others

Acceleration status was not significantly related to responses about the influence of significant others or events across or with groups.

Reasons to Work

Accelerated boys were more likely than non-accelerates to say "society and family expect me to work" is either a very important or a not important reason. Non-accelerated girls in the Career Class and non-accelerated boys in the Talent Search group responded "very important" more often than their accelerated cohorts to "obligation to society" as a reason to work.

Level of Educational Aspiration

Acceleration status was not significantly related to educational aspirations.

Factors in Job Selection

For boys acceleration was related to the perception of the importance of the amount of mathematics needed in that non-accelerates viewed this as not important. Accelerated girls were more concerned than non-accelerates about the cost of education needed for the job whereas non-accelerated girls were more likely to be concerned about doing the job well, earning a high salary, and the availability of job openings. Thus, the non-accelerated girls appear to be more conservative and practical than idealistic about career selection.

Investigative Career Interests

A large percentage of students with investigative career interests than non-investigative interests were accelerated but this difference was not statistically significant.

Career and Life Style Plans

Acceleration and life style plans were related for girls but not boys. Accelerated girls were more likely to desire full time careers always and less likely to have limited career goals than were non-accelerates.

CONCLUSIONS

The major finding of this study is that special programs for the mathematically gifted do have an impact on the course-taking behaviors and plans and aspirations of girls. Girls who participated in special School System accelerated mathematics classes achieved as well as the boys in these classes and indicate a strong commitment to studying advanced mathematics courses. Girls who participated in a program which included a career awareness component and exposure to female role models had higher levels of educational aspiration than boys or girls who received no treatment or an accelerated mathematics program only. Girls who participated in any type of treatment program were less likely than girls who were not in programs to have weak career commitments for their life-style plans. The completion rate of boys and girls in the school system programs were, however, somewhat low and such programs would probably be more successful if they were conducted during the regular school day rather than after school hours or weekends.

Although some sex differences were found on attitudinal and interest measures, over all mathematically able boys and girls, particularly the seventh graders in the 1978 Talent Search are more alike than different with respect to attitudes and interests. It appears that the younger generation of mathematically gifted girls have more positive perceptions of the importance of studying mathematics than past generations of gifted girls. The areas in which boys and girls differ most relate to reasons to work and career and life style expectations for themselves and their future spouses. Although girls feel less pressured to work because of financial necessity or social expectations than do the boys, the majority do seem oriented towards post-secondary education and graduate schools and an eventual professional career. These girls, however, may still need a great deal of support and encouragement in order to realize their potentials. It is clear that the attitudes of their male cohorts are not totally supportive. Although the percentage of boys who still stereotype mathematics as a male domain is small, the majority of the boys are not expecting their future wives to have a strong commitment to careers. Thus, programs aimed at increasing women's participation in the world of work at the professional levels should direct some attention to the attitudes of boys. Perhaps these gifted boys need exposure to professional females as role models just as much as do the gifted girls.

Chapter VI

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APPENDIX

TABLES RELATED TO SELECTION OF HOPKINS' ALL-GIRLS ACCELERATED CLASS AND CONTROL GROUPS

Table A Tukey Comparison of Mean Scores on the SAT-M for the Hopkins All-Girls Accelerated Class and the Control Groups

Comparison	Difference	Level of Significance
Experimental girls vs. control girls	3	not significant
Experimental girls vs. control boys	-8	$p < .05$
Control girls vs. control boys	-10	$p < .05$

Table B Analysis of Variance of SAT-M Scores for the Hopkins All-Girls Accelerated Class and the Control Groups

Sources of Variation	df	MS	F
Group (G)	2	785.897	5.699*
Triad (T)	25	8016.820	
GT	50	137.897	
Total	77		

* $p < .01$

QUESTIONNAIRE ADMINISTERED TO SCHOOL SYSTEMS A, B AND C

ID # ____________________ Date: ____________________

Grade in School: ____________ Sex (circle one) F M

1. Below is a list of mathematics and mathematics-related courses. Please put a check in the column that describes your plans for enrolling in these courses.

	I have already taken	I definitely plan to take	I probably will take	I don't know	I will not take
a. Algebra I	____	____	____	____	____
b. Algebra II	____	____	____	____	____
c. Plane Geometry	____	____	____	____	____
d. Solid Geometry	____	____	____	____	____
e. Trigonometry	____	____	____	____	____
f. Analytic Geometry	____	____	____	____	____
g. Elem. Functions/ Pre-Calculus	____	____	____	____	____
h. Calculus	____	____	____	____	____
i. Statistics	____	____	____	____	____
j. Probability Theory	____	____	____	____	____
k. Computer Science	____	____	____	____	____
l. Chemistry	____	____	____	____	____
m. Physics	____	____	____	____	____
n. Business Math.	____	____	____	____	____

2. List names of any mathematics or related course(s) you expect to study in high school that was (were) not included in the above list:

   ____

3. Which of the above course(s) are you taking THIS YEAR? List the course(s) on this line: ____

4. Which of the above course(s) are you planning to take NEXT YEAR? List the course(s) on this line: ____

5. Below are reasons why some people do or do not study mathematics beyond Algebra I. For each reason listed, check the column that best describes how important these reasons are for you.

	Not Important	Somewhat Important	Very Important
a. Mathematics will be important for my future career	___	___	___
b. Many of my friends will be taking advanced mathematics courses	___	___	___
c. Advanced mathematics is required to get into a good college	___	___	___
d. Mathematics teaches logical thinking	___	___	___
e. Mathematics is interesting to study	___	___	___
f. Mathematics is necessary in this technological age	___	___	___
g. Mathematics is easy to learn	___	___	___

6. What other reasons are important to you?

7. People often can remember an experience or a person that helped them become interested or good in mathematics.

   a. Please describe any special experience(s) or person(s) in your life that has (have) been a strong factor in helping you become interested and/or good in mathematics. (If it is a person, do not give us a name but describe the relationship to you, such as "seventh grade mathematics teacher", "best friend", "mother", etc.)

   b. How did this experience or person influence your feelings about mathematics?

   c. What age were you when this influence took place?

8. Check the highest level of education you expect to complete (check only one).

☐ a) high school

☐ b) vocational, trade or business school

☐ c) two-year or junior college

☐ d) four-year college

☐ e) graduate or professional school after college

9. List three careers that at the present time appeal to you, in order of your preference.

> Please try to be as specific as you can. For example: Rather than say "scientist", say "geologist", "lab technician"; rather than say "teacher", say "high school social studies teacher", "mathematics professor in college", "kindergarten teacher."

1st choice occupation ______________________________

2nd choice occupation ______________________________

3rd choice occupation ______________________________

10. Check the column that best describes how important each of the following reasons for working are to you.

	Not Important	Somewhat Important	Very Important
a) Society and my family will expect me to work.	___	___	___
b) It will probably be financially necessary for me to work	___	___	___
c) I feel an obligation to myself to develop and use my talents.	___	___	___
d) I feel an obligation to society to develop and use my talents.	___	___	___
e) I would probably be bored if I did not work.	___	___	___

11. Which of the above is the most important factor affecting your decision to work: Please write in the letter of the above factor ☐.

12. How important will each of the following factors be to you in selecting your specific job or career, when the time comes? Check the column that best describes how important each of these factors is to you.

	Not Important	Somewhat Important	Very Important
a) Amount of mathematics needed	___	___	___
b) Amount of education needed	___	___	___
c) Cost of the education needed	___	___	___
d) Belief that I will be able to do the job well	___	___	___
e) Belief that I will enjoy the job	___	___	___
f) Opportunity to use my special abilities to the fullest	___	___	___
g) Opportunity to earn a high salary	___	___	___
h) Having a position that is looked up to by others	___	___	___
i) Possibility of a flexible time schedule	___	___	___
j) Challenge of difficult work	___	___	___
k) Many job openings in the field	___	___	___
l) Opportunities to be helpful to others or useful to society	___	___	___
m) Chance to work with people rather than things	___	___	___

13. Which of the above do you feel will be the most important factor in your selection of a job or career? Please write the letter of the factor here ☐.

14. Describe any other factor(s) you consider important that was (were) not included in the above list.

15. Career and life style expectations have been changing over the past several decades. Although it is sometimes difficult to know how you will feel in the future, try to project to the time when you have finished your educational training. Which of these career options would be most consistent with your future plans?

After I have completed my educational training, I plan to: (Check only one)

☐ a) Have a full time career, marry and have children.

☐ b) Have a full time career, marry, but have no children.

☐ c) Have a full time career and remain unmarried.

☐ d) Have a part time career while my children are small and a full time career before they are born and after they are grown.

☐ e) Have a part time career always.

☐ f) Have a full time career only until I marry.

☐ g) Have a full time career only until my children are born, then stop working outside the home to raise the children.

☐ h) Never work outside the home.

16. If you get married, which of the above options would you prefer your marriage partner to choose? Write the letter of the option ☐.

17. If there are any options you would choose for yourself or your marriage partner that are not listed above, please explain them.

The questions below are specifically about the special accelerated mathematics (Algebra I, II, or Geometry) classes you have taken in your school system. Check only one answer that best completes the statements.

18. The most enjoyable aspect of the special mathematics classes was:

    ☐ a) The chance to meet other students who were as interested in mathematics as I was.

    ☐ b) The challenge of doing difficult work.

    ☐ c) The opportunity to move ahead in mathematics.

    ☐ d) The fact that the teacher was very knowledgeable and enthusiastic about mathematics.

    ☐ e) Other (specify): ______________________

19. The least enjoyable aspect of the special mathematics classes was:

    ☐ a) Too much homework.

    ☐ b) The work was too difficult.

    ☐ c) There were too many students in the class who were smarter than I.

    ☐ d) The fact that the class could not be held during the regular school day and had to be held either after school or on Saturdays.

    ☐ e) Other (specify): ______________________

20. Being in the special mathematics class has:

    ☐ a) Greatly increased my interest in studying mathematics.

    ☐ b) Somewhat increased my interest in studying mathematics.

    ☐ c) Had no effect on my interest in studying mathematics.

    ☐ d) Decreased my interest in studying mathematics.

    ☐ e) Other (specify): ______________________

QUESTIONNAIRE ADMINISTERED TO THE TALENT SEARCH

Intellectually Gifted Child Study Group
(IGCSG)

105 Whitehead Hall
THE JOHNS HOPKINS UNIVERSITY
Baltimore, Maryland 21218 301-338-8276

Name: ____________________ Name of School ____________________ County __________

Grade in School: ____________________ Sex (circle one) F M Date __________

1. Below is a list of mathematics and mathematics-related courses. Please put a check in the column that describes your plans for enrolling in these courses.

	I have already taken	I definitely plan to take	I probably will take	I don't know	I will not take
a. Algebra I	___	___	___	___	___
b. Algebra II	___	___	___	___	___
c. Plane Geometry	___	___	___	___	___
d. Solid Geometry	___	___	___	___	___
e. Trigonometry	___	___	___	___	___
f. Analytic Geometry	___	___	___	___	___
g. Elem. Functions/ Pre-Calculus	___	___	___	___	___
h. Calculus	___	___	___	___	___
i. Statistics	___	___	___	___	___
j. Probability Theory	___	___	___	___	___
k. Computer Science	___	___	___	___	___
l. Chemistry	___	___	___	___	___
m. Physics	___	___	___	___	___
n. Business Math.	___	___	___	___	___

2. List names of any mathematics or related course(s) you expect to study in high school that was (were) not included in the above list:

____

3. Which of the above course(s) are you taking THIS YEAR? List them on this line: ____

4. Which of the above course(s) are you planning to take NEXT YEAR? List them on this line: ____

5. Below are reasons why some people do or do not study mathematics beyond Algebra I. For each reason listed, check the column that best describes how important these reasons are for you:

	Not Important	Somewhat Important	Very Important
a. Mathematics will be important for my future career.	___	___	___
b. Many of my friends will be taking advanced mathematics courses.	___	___	___
c. Advanced mathematics is required to get into a good college.	___	___	___
d. Mathematics teaches logical thinking.	___	___	___
e. Mathematics is interesting to study.	___	___	___
f. Mathematics is necessary in this technological age.	___	___	___
g. Mathematics is easy to learn.	___	___	___

6. What other reasons are important to you?

7. People often can remember a person or an experience that helped them become interested or good in mathematics.

   a. Please describe any special experience(s) or person(s) in your life that has (have) been a strong factor in helping you become interested and/or good in mathematics. (If it is a person, do not give us a name but describe the relationship to you, such as "seventh grade mathematics teacher", "best friend", "mother", etc.)

   b. How did this experience or person influence your feelings about mathematics?

   c. What age were you when this influence took place?

8. Check the highest level of education you expect to complete (check only one).

☐ a) high school

☐ b) vocational, trade or business school

☐ c) two-year or junior college

☐ d) four-year college

☐ e) graduate or professional school after college

9. List three careers that at the present time appeal to you, in order of your preference:

> Please try to be as specific as you can. For example: Rather than write "scientist", write "geologist", "lab technician"; rather than write "teacher", write "high school social studies teacher", "mathematics professor in college", "kindergarten teacher."

1st choice occupation ____________________

2nd choice occupation ____________________

3rd choice occupation ____________________

10. Check the column that best describes how important each of the following reasons for working are to you.

	Not Important	Somewhat Important	Very Important
a) Society and my family will expect me to work.	___	___	___
b) It will probably be financially necessary for me to work	___	___	___
c) I feel an obligation to myself to develop and use my talents.	___	___	___
d) I feel an obligation to society to develop and use my talents.	___	___	___
e) I would probably be bored if I did not work.	___	___	___

11. Which of the above is the most important factor affecting your decision to work? Please write in the letter of the above factor: ☐.

12. How important will each of the following factors be to you in selecting your specific job or career, when the time comes? Check the column that best describes how important each of these factors is to you.

	Not Important	Somewhat Important	Very Important
a) Amount of mathematics needed	___	___	___
b) Amount of education needed	___	___	___
c) Cost of the education needed	___	___	___
d) Belief that I will be able to do the job well	___	___	___
e) Belief that I will enjoy the job	___	___	___
f) Opportunity to use my special abilities to the fullest	___	___	___
g) Opportunity to earn a high salary	___	___	___
h) Having a position that is looked up to by others	___	___	___
i) Possibility of a flexible time schedule	___	___	___
j) Challenge of difficult work	___	___	___
k) Many job openings in the field	___	___	___
l) Opportunities to be helpful to others or useful to society	___	___	___
m) Chance to work with people rather than things	___	___	___

13. Which of the above do you feel will be the most important factor in your selection of a job or career? Please write the letter of the factor here: ☐.

14. Describe any other factor(s) you consider important that was (were) not included in the above list.

15. Career and life-style expectations have been changing over the past several decades. Although it is sometimes difficult to know how you will feel in the future, try to project to the time when you have finished your educational training. Which of these career options would be most consistent with your future plans?

After I have completed my educational training, I plan (check only one):

- ☐ a) to have a full time career, marry and have children.
- ☐ b) to have a full time career, marry, but have no children.
- ☐ c) to have a full time career and remain unmarried.
- ☐ d) to have a part time career while my children are small and a full time career before they are born and after they are grown.
- ☐ e) to have a part time career always.
- ☐ f) to have a full time career only until I marry.
- ☐ g) to have a full time career only until my children are born, then stop working outside the home to raise the children.
- ☐ h) never to work outside the home.

16. If you get married, which one of the above options would you prefer your marriage partner to choose: Write the letter of the option: ☐.

17. If there are any options you would choose for yourself or your marriage partner that are not listed above, please explain them below:

18. Have you been invited to participate in any special mathematics programs in your school or school system? Yes ____ No____

If yes, a) briefly describe the program:

b) did you eventually participate? Yes____ No____

Why or why not?

19. Try to remember what happened when you were first invited to participate in the Talent Search:

What did the following people do or say that encouraged or discouraged you from being in the Talent Search: Your teachers, your counselors, your parents, your classmates or friends?

What do you think was the major reason you decided to participate in the Talent Search?

20. Describe any activities you did to prepare yourself for taking the SAT. Who, if anyone, worked or studied with you (for example: mother, father, teacher, friend)?

21. Has being in the Talent Search affected the way you feel about yourself in general or specifically with respect to mathematics? (For example, do you think you have more or less self confidence about trying something difficult? Has it changed your ideas about your career goals or educational plans?)

22. If a younger friend, brother, or sister was invited to be in another Talent Search next year and asked your advice and opinion about whether or not to participate, what would you tell him or her?

23. Some people think that mathematics is a "masculine" activity and that boys are better than girls at mathematics. Do your classmates and friends at school hold this view? What makes you think they do or don't? (For example, what do they say about girls who are "good at math"?)

QUESTIONNAIRE ADMINISTERED TO THE CAREER CLASS

ID # ______________________ Date: ______________________

Grade in School: ______________ Sex (circle one) F M

1. Below is a list of mathematics and mathematics-related courses. Please put a check in the column that describes your plans for enrolling in these courses.

	I have already taken	I definitely plan to take	I probably will take	I don't know	I will not take
a. Algebra I	___	___	___	___	___
b. Algebra II	___	___	___	___	___
c. Plane Geometry	___	___	___	___	___
d. Solid Geometry	___	___	___	___	___
e. Trigonometry	___	___	___	___	___
f. Analytic Geometry	___	___	___	___	___
g. Elem. Functions/ Pre-Calculus	___	___	___	___	___
h. Calculus	___	___	___	___	___
i. Statistics	___	___	___	___	___
j. Probability Theory	___	___	___	___	___
k. Computer Science	___	___	___	___	___
l. Chemistry	___	___	___	___	___
m. Physics	___	___	___	___	___
n. Business Math.	___	___	___	___	___

2. List names of any mathematics or related course(s) you expect to study in high school that was (were) not included in the above list:

____

3. Which of the above course(s) are you taking THIS YEAR? List the course(s) on this line: ______________________________

4. Which of the above course(s) are you planning to take NEXT YEAR? List the course(s) on this line: ______________________________

5. Below are reasons why some people do or do not study mathematics beyond Algebra I. For each reason listed, check the column that best describes how important these reasons are for you.

	Not Important	Somewhat Important	Very Important
a. Mathematics will be important for my future career	___	___	___
b. Many of my friends will be taking advanced mathematics courses	___	___	___
c. Advanced mathematics is required to get into a good college	___	___	___
d. Mathematics teaches logical thinking	___	___	___
e. Mathematics is interesting to study	___	___	___
f. Mathematics is necessary in this technological age	___	___	___
g. Mathematics is easy to learn	___	___	___

6. What other reasons are important to you?

7. People often can remember an experience or a person that helped them become interested or good in mathematics.

a. Please describe any special experience(s) or person(s) in your life that has (have) been a strong factor in helping you become interested and/or good in mathematics. (If it is a person, do not give us a name but describe the relationship to you, such as "seventh grade mathematics teacher", "best friend", "mother", etc.)

b. How did this experience or person influence your feelings about mathematics?

c. What age were you when this influence took place?

8. Check the highest level of education you expect to complete (check only one).

☐ a) high school

☐ b) vocational, trade or business school

☐ c) two-year or junior college

☐ d) four-year college

☐ e) graduate or professional school after college

9. List three careers that at the present time appeal to you, in order of your preference.

> Please try to be as specific as you can. For example: Rather than say "scientist", say "geologist", "lab technician"; rather than say "teacher", say "high school social studies teacher", "mathematics professor in college", "kindergarten teacher."

1st choice occupation ______________________________

2nd choice occupation ______________________________

3rd choice occupation ______________________________

10. Check the column that best describes how important each of the following reasons for working are to you.

	Not Important	Somewhat Important	Very Important
a) Society and my family will expect me to work.	___	___	___
b) It will probably be financially necessary for me to work	___	___	___
c) I feel an obligation to myself to develop and use my talents.	___	___	___
d) I feel an obligation to society to develop and use my talents.	___	___	___
e) I would probably be bored if I did not work.	___	___	___

11. Which of the above is the most important factor affecting your decision to work: Please write in the letter of the above factor ☐.

12. How important will each of the following factors be to you in selecting your specific job or career, when the time comes? Check the column that best describes how important each of these factors is to you.

	Not Important	Somewhat Important	Very Important
a) Amount of mathematics needed	___	___	___
b) Amount of education needed	___	___	___
c) Cost of the education needed	___	___	___
d) Belief that I will be able to do the job well	___	___	___
e) Belief that I will enjoy the job	___	___	___
f) Opportunity to use my special abilities to the fullest	___	___	___
g) Opportunity to earn a high salary	___	___	___
h) Having a position that is looked up to by others	___	___	___
i) Possibility of a flexible time schedule	___	___	___
j) Challenge of difficult work	___	___	___
k) Many job openings in the field	___	___	___
l) Opportunities to be helpful to others or useful to society	___	___	___
m) Chance to work with people rather than things	___	___	___

13. Which of the above do you feel will be the most important factor in your selection of a job or career? Please write the letter of the factor here ☐.

14. Describe any other factor(s) you consider important that was (were) not included in the above list.

15. Career and life style expectations have been changing over the past several decades. Although it is sometimes difficult to know how you will feel in the future, try to project to the time when you have finished your educational training. Which of these career options would be most consistent with your future plans?

After I have completed my educational training, I plan to: (Check only one)

☐ a) Have a full time career, marry and have children.

☐ b) Have a full time career, marry, but have no children.

☐ c) Have a full time career and remain unmarried.

☐ d) Have a part time career while my children are small and a full time career before they are born and after they are grown.

☐ e) Have a part time career always.

☐ f) Have a full time career only until I marry.

☐ g) Have a full time career only until my children are born, then stop working outside the home to raise the children.

☐ h) Never work outside the home.

16. If you get married, which of the above options would you prefer your marriage partner to choose? Write the letter of the option ☐.

17. If there are any options you would choose for yourself or your marriage partner that are not listed above, please explain them.

18. Have you participated in any special math programs in your school? Yes___ No___
If yes, briefly describe this program:

19. What, if any, benefits do you feel you got from participating in the Career Awareness program at Hopkins in the summer of 1977? (Continue on back if not enough space on this page.)

20. Try to remember when you were first invited to participate in the Career Awareness class. What did the following people do or say that encouraged or discouraged you from being in the class: your teachers, your counselors, your parents, your classmates or friends? What do you think was the major reason you decided to be in the class? (For example, was one of your best friends going to join the class?)

21. What "things" about being in the Career Awareness Class did you like and dislike? (For example, coming to Hopkins, the other students in the class, specific topics studied, etc.)

I liked the following aspects of the class:

I dislike the following aspects of the class:

22. At any time, did you feel like you wanted to drop out of the Career Awareness class? Why? If you didn't leave, what made you decide to stay?

23. Did being in the class affect the way you feel about yourself with respect to mathematics or how you feel about yourself in general? (For example, has it changed your ideas about your career or educational goals? Do you like mathematics more or less than you did before?)

24. If a younger friend, brother or sister was invited to participate in a Career Awareness class like the one you participated in and asked your advice and opinion about the class, what would you tell him or her?

25. Some people think mathematics is a "masculine" activity and that boys are better than girls at mathematics. Do your classmates and friends at school hold this view? What makes you think they do or don't? (For example, what do they say about girls who are "good" at math?)

QUESTIONNAIRE ADMINISTERED TO SCHOOL SYSTEM D

ID # ______________________ Date: ______________________

Grade in School: ______________ Sex (circle one) F M

I. Below is a list of mathematics and mathematics-related courses. Please put a check in the column that describes your plans for enrolling in these courses.

	I have already taken	I definitely plan to take	I probably will take	I don't know	I will not take
a. Algebra I	____	____	____	____	____
b. Algebra II	____	____	____	____	____
c. Plane Geometry	____	____	____	____	____
d. Solid Geometry	____	____	____	____	____
e. Trigonometry	____	____	____	____	____
f. Analytic Geometry	____	____	____	____	____
g. Elem. Functions/ Pre-Calculus	____	____	____	____	____
h. Calculus	____	____	____	____	____
i. Statistics	____	____	____	____	____
j. Probability Theory	____	____	____	____	____
k. Computer Science	____	____	____	____	____
l. Chemistry	____	____	____	____	____
m. Physics	____	____	____	____	____
n. Business Math.	____	____	____	____	____

II. List names of any mathematics or related course(s) you expect to study in high school that was (were) not included in the above list:

____

III. Which of the above course(s) are you taking this year? List the course(s) on this line: ____

IV. Which of the above course(s) are you planning to take next year? List the course(s) on this line: ____

V. Check the highest level of education you expect to complete (check only one).

____ a) high school
____ b) vocational, trade or business school
____ c) two year or junior college
____ d) four year college
____ e) graduate or professional school after college

VI. List three careers that at the present time appeal to you, in order of your preference. (Please try to be as specific as you can. For example: Rather than say "scientist", say "geologist", "lab technician"; rather than say "teache say "high school social studies teacher", "mathematics professor in college", "kindergarten teacher.")

1st choice occupation ______________________________

2nd choice occupation ______________________________

3rd choice occupation ______________________________

Results of the Pilot Testing of the Questionnaire

In order to check whether or not questions would be understood by the possible respondents, a pilot test of the questionnaire was conducted in June. Students were first given the questionnaire with written instructions, then an interviewer discussed each question with the respondent to clarify the meaning of the questions and the response. Information gathered from the follow-up interview was not used except for anecdotal purposes because the purpose of those interviews was to determine the clarity of the questions on the questionnaire.

Only part of the questionnaire was administered during the pilot testing; questions I-IV, soliciting course-taking information, were not included since they were very straightforward and no problems were anticipated. Questions XVI-XVIII were not included because they were not relevant to the population being pilot tested.

A copy of the questionnaire, as it was administered to the students in the pilot tested group, with the results tabulated directly on the form, constitutes Figure A. To make it easier to include in the report, the questionnaire was duplicated on short paper, although legal size was used in the actual testing situation, to allow the students more room to write comments if they wished.

Insert Figure A

Since the group used for the pilot testing was extremely homogeneous, no differences were expected to emerge on the questionnaire. These expectations did hold true. What did emerge, however, was an interesting composite of plans and aspirations of these extremely mathematically able boys.

Utilitarian reasons for taking advanced mathematics were judged to be the most important. In question V, which listed several reasons why people take advanced mathematics, the three most popular reasons considered to be

Figure A : Selected Questionnaire Items Used For Pilot Testing and Number of Boys Responding To Each Item

V. Below are reasons why some people do or do not study advanced mathematics beyond the required number of courses. For each reason listed, check the column that best describes how important these reasons are for you.

	Not Important	Somewhat Important	Very Important
a. I enjoy studying mathematics	2	8	8
b. Mathematics will be important for my future career	0	4	14
c. Many of my friends will be taking advanced mathematics courses	6	12	0
d. Advanced mathematics is required to get into a good college	1	5	12
e. I am good in mathematics	2	6	10
f. Mathematics teaches logical thinking	4	8	6
g. Mathematics is necessary in this technological age	0	6	12

VI. Please describe any special experience or person(s) in your life that has (have) been a strong factor in helping you to become interested and good at mathematics. (If it is a person, do not give us a name but describe the relationship to you, such as "seventh grade mathematics teacher", "best friend", "mother", etc.)

VII. Check the highest level of education you expect to complete (check only one).

___ a) high school
___ b) vocational, trade or business school
___ c) two year or junior college
1 d) four year college
17 e) graduate or professional school after college

VIII. List three careers that at the present time appeal to you, in order of your preference:

1. ______________________________
2. ______________________________
3. ______________________________

IX. Check the column that best describes how important each of the following reasons for working are to you.

		Not Important	Somewhat Important	Very Important
a)	Society and my family will expect me to work.	2	8	8
b)	It will probably be financially necessary for me to work.	0	4	14
c)	I feel an obligation to myself to develop and use my talents.	1	7	10
d)	I feel an obligation to society to develop and use my talents.	2	11	5
e)	I would probably be bored if I did not work.	4	8	6

X. Which of the above is the most important factor affecting you decision to work: Please write in the letter of the above factor:

a)=3; b)=8; c)=4; d)=0; e)=2 One student could not decide ~~on~~ a "most important" factor.

XI. How important will each of the following factors be to you in selecting your specific job or career, when the time comes? Check the column that best describes how important each of these factors is to you.

			Not Important	Somewhat Important	Very Important
0	a)	Amount of mathematics needed	1	11	5 (1 blank)
[illegible]	b)	Amount of education needed	4	8	6
[illegible]	c)	Cost of the education needed	4	11	3
3	d)	Belief that I will be able to do the job well	0	3	15
8	e)	Belief that I will enjoy the job	0	1	17
3	f)	Opportunity to use my special abilities to the fullest	0	6	12
[illegible]	g)	Opportunity to earn a high salary	0	8	10
[illegible]	h.	Having a position that is looked up to by others	4	10	4
0	i.	Possibility of a flexible time schedule	3	7	8
1	j.	Challenge of difficult work	2	7	9
[illegible]	k.	Many job openings in the field	4	7	7
0	l.	Job is traditionally done by members of the opposite sex	15	2	1
1	m.	Opportunities to be helpful to others or useful to society	3	8	7
[illegible]	n.	Chance to work with people rather than things	7	7	4

XII. Which of the above do you feel will be the most important factor in your selection of a job or career? Please write the letter of the factor here ______

The letters to the left of each question above indicate how may chose that answer as most important.

XIII. List any other factor(s) you consider important that was (were) not included in the above list.

Figure A (continued)

XIV. Suppose a job you were considering has traditionally been done by members of the opposite sex. How would you feel about this?

Had no feelings of discomfort (5)
Would feel somewhat uncomfortable but would take the job (6)
Would feel very uncomfortable and would probably not take the job (7)

XV. Career and life style expectations for women have been changing over the past several decades. Although it is sometimes difficult to know how you will feel in the future, try to project to the time when you have finished your educational training. If you are a girl, answer this question as it best expresses your intentions. If you are a boy, answer it from the point of view of what you would like your wife to do.

After I have completed my educational training, I plan to: (Check only one)

1 a) Have a full time career, while married and raising a family.

0 b) Have a full time career, while married, but have no children.

* 1 c) Have a full time career and remain unmarried.

11 d) Have a part time career while my children are small and a full time career before they are born and after they are grown.

2 e) Have a part time career always.

0 f) Have a full time career only until I am married, then stop working outside the home.

3 g) Have a full time career until my children are born, then I will stop working outside the home to raise the children.

0 h) Never work outside the home.

* This student was answering for himself and not a hypothetical wife. When questioned during the interview, he said that since he was not planning to be married, he could not answer the question.

very important were, "Mathematics is necessary in this technological age", "Mathematics is important for a career," and "Mathematics is required to get into a good college." Since all but one of the students already plan to go to graduate school, this is not surprising. Less practical reasons, such as mathematics is easy or interesting or teaches logical thinking were not nearly as popular. None of the boys felt that the fact that many of their friends would be in the advanced mathematics classes was a very important reason for them to take the classes.

Clearly teachers and parents had the most influence on these students' awareness of their mathematics ability and in helping them in the pursuit of mathematics. Except for mention of the Talent Search and the Study of Mathematically Precocious Youth (SMPY) by a few of the boys, all their encouragement was from family or teachers.

With the exception of one boy's second choice career as politician, all the boys possible future career choices were mathematical or scientific. Most of the boys perceive careers as a necessity for financial reasons with only four listing that as somewhat important and none claiming it had no importance. Although ten felt that it was very important that they use and develop their talents as an obligation to themselves, only 5 felt their obligation to society was of similar importance. In view of this it was not surprising that 17 of the boys felt it was very important that they base their career choice on their belief that they will enjoy the job and fifteen also felt it was very important that they be able to do the job well. Other answers which were judged very important by more than one half the boys were opportunities to use talents to their fullest, and opportunities to earn a high salary. Altruistic and socially oriented reasons do not seem to be at all important to these boys as reasons for choosing specific careers.

Question XIV, "Suppose that a job you were considering has traditionally been done by members of the opposite sex. How would you feel about working at that job?" was intended to see if boys were affected by the pressures girls who see mathematics as a male domain are believed to feel. Although this was an open ended question, the results were tabulated in three categories: those who would be very uncomfortable about taking the job (7), those who would be somewhat uncomfortable (6) and those who wouldn't care at all (5). Clearly most of the boys were not pleased with a future job in which they could be expected to be the only male in the work group.

In the interviews, it was discovered that some of the boys felt that if the job was traditionally considered "women's work", it could not be expected to be at the high level they were anticipating their future careers to be and it was this perception of the low level job, rather than the fact that they would be working with females that discouraged them.

Unfortunately, this question could not be used in the final questionnaire, partially because of school system objections and partially because it was difficult to rework the directions so that the issue of working with the opposite sex and the perception of female jobs as low level ones did not become confused. It would have been interesting to see what girls' reactions to this question would have been. We have tentative plans to include a similar question in our interviews and it may be possible to have some comparison data after the interviews are completed.

Question XV was designed to see whether stereotypic views of female roles prevail. The answers to this question reveal that, for those boys, women still have the primary responsibility for raising children. Only one boy preferred his future wife have a full time career, while married and raising a family. The most common answer, chosen by 11 of the boys, was that their wives should have a part time career while the children were small and full time employment before they were born and after they are grown. Other answers chosen were "Have a part time career always," and "Have a full time career until the children are born and then stop working completely to raise the children." Clearly most of the boys are expecting that their wives will place their home responsibilities above any career choices they may have made.

The picture that emerges of these eighteen extremely mathematically able boys is that they have largely been unaffected by the storms brewing concerning changing life styles or career patterns for women. They are expecting to work for financial necessity when they grow up so they are choosing careers that are compatible with their own perceptions of what they will enjoy and the necessity to earn a good living. Society's needs are unimportant unless they happen to coincide with the boys' own needs. The boys perceive traditionally female jobs as unacceptable and to a certain extent as of lesser importance and expect their wives to fit into the traditional role of rearing the children.

Although this was a pilot testing and by no means a definitive study, the results that are suggested from the data appear interesting. During the second year of the grant, the questionnaire will be given to larger groups, including girls.

FENNEMA-SHERMAN MATHEMATICS ATTITUDE SCALE

DIRECTIONS

On the following pages is a series of statements. There are no "correct" answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. Suppose the statement is:

Example Statement: I like mathematics. SA A U D SD

As you read the statement, you will know whether you agree or disagree. If you strongly agree, circle the letters SA (which stand for strongly agree). If you agree but with reservations, that is, you do not fully agree, circle the letter A (which stands for agree). If you disagree with the idea, indicate the extent to which you disagree by circling letter D if you disagree or letters SD if you strongly disagree. If you neither agree nor disagree, that is, you are not certain, circle letter U (which stands for undecided). Also, if you cannot answer a question circle letter U.

Now answer the Example Statement above.

Do not spend much time with any statement, but be sure to answer every statement. Work fast but carefully.

There are no "right" or "wrong" answers. The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you help you make a choice.

THIS INVENTORY IS BEING USED FOR RESEARCH PURPOSES ONLY
AND NO ONE WILL KNOW WHAT YOUR RESPONSES ARE

This scale was developed under a grant from the National Science Foundation.

ID Number ______________________

Age ______________________

Grade ______________________

Sex ______________________

Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

1. My father thinks I'll need mathematics for what I want to do after I graduate from high school. SA A U D SD
2. It would make me happy to be recognized as an excellent student in mathematics. SA A U D SD
3. I think I could handle more difficult mathematics. SA A U D SD
4. I have a lot of self-confidence when it comes to math. SA A U D SD
5. I am challenged by math problems I can't understand immediately. SA A U D SD
6. My father has shown no interest in whether or not I take more math courses. SA A U D SD
7. It would make people like me less if I were a really good math student. SA A U D SD
8. I don't like people to think I'm smart in math. SA A U D SD
9. In terms of my adult life it is not important for me to do well in mathematics in high school. SA A U D SD
10. If I had good grades in math, I would try to hide it. SA A U D SD
11. My father thinks I need to know just a minimum amount of math. SA A U D SD
12. I would have more faith in the answer for a math problem solved by a man than a woman. SA A U D SD
13. The challenge of math problems does not appeal to me. SA A U D SD
14. When a math problem arises that I can't immediately solve, I stick with it until I have the solution. SA A U D SD
15. I am sure that I can learn mathematics. SA A U D SD

ID NUMBER ____________________

Remember: Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

16.	Girls who enjoy studying math are a bit peculiar.	SA	A	U	D	SD
17.	My mother has strongly encouraged me to do well in mathematics.	SA	A	U	D	SD
18.	I have had a hard time getting teachers to talk seriously with me about mathematics.	SA	A	U	D	SD
19.	It would be really great to win a prize in mathematics.	SA	A	U	D	SD
20.	If I got the highest grade in math I'd prefer no one knew.	SA	A	U	D	SD
21.	I'll need a firm mastery of mathematics for my future work.	SA	A	U	D	SD
22.	I have found it hard to win the respect of math teachers.	SA	A	U	D	SD
23.	I expect to have little use for mathematics when I get out of school.	SA	A	U	D	SD
24.	I will use mathematics in many ways as an adult.	SA	A	U	D	SD
25.	When it comes to anything serious I have felt ignored when talking to math teachers.	SA	A	U	D	SD
26.	Females are as good as males in geometry.	SA	A	U	D	SD
27.	I would trust a woman just as much as I would trust a man to figure out important calculations.	SA	A	U	D	SD
28.	Math teachers have made me feel I have the ability to go on in mathematics.	SA	A	U	D	SD
29.	My father hates to do math.	SA	A	U	D	SD
30.	When a question is left unanswered in math class, I continue to think about it afterward.	SA	A	U	D	SD
31.	My mother thinks that mathematics is one of the most important subjects I have studied.	SA	A	U	D	SD
32.	Generally I have felt secure about attempting mathematics.	SA	A	U	D	SD

ID NUMBER ____________________

Remember: Circle the letters that correspond to your answer:

SA=Strongly Agree   A=Agree   U=Undecided   D=Disagree   SD=Strongly Disagree

33. Mathematics is of no relevance to my life. SA A U D SD

34. I do as little work in math as possible. SA A U D SD

35. I don't understand how some people can spend so much time on math and seem to enjoy it. SA A U D SD

36. My father thinks advanced math is a waste of time for me. SA A U D SD

37. My mother has always been interested in my progress in mathematics. SA A U D SD

38. Women certainly are logical enough to do well in mathematics. SA A U D SD

39. Being regarded as smart in mathematics would be a great thing. SA A U D SD

40. My mother has shown no interest in whether or not I take more math courses. SA A U D SD

41. Winning a prize in mathematics would make me feel unpleasantly conspicuous. SA A U D SD

42. It's hard to believe a female could be a genius in mathematics. SA A U D SD

43. Figuring out mathematical problems does not appeal to me. SA A U D SD

44. When a woman has to solve a math problem, it is feminine to ask a man for help. SA A U D SD

45. My math teachers have been interested in my progress in mathematics. SA A U D SD

46. As long as I have passed, my father hasn't cared how I have done in math. SA A U D SD

47. Most subjects I can handle O.K., but I have a knack for flubbing up math. SA A U D SD

48. I would expect a woman mathematician to be a masculine type of person. SA A U D SD

ID NUMBER ____________________

Remember: Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

49.	Math has been my worst subject.	SA	A	U	D	SD
50.	My father has always been interested in my progress in mathematics.	SA	A	U	D	SD
51.	I see mathematics as a subject I will rarely use in my daily life as an adult.	SA	A	U	D	SD
52.	Girls can do just as well as boys in mathematics.	SA	A	U	D	SD
53.	Once I start trying to work on a math puzzle, I find it hard to stop.	SA	A	U	D	SD
54.	I can get good grades in mathematics.	SA	A	U	D	SD
55.	Math puzzles are boring.	SA	A	U	D	SD
56.	For some reason even though I study, math seems unusually hard for me.	SA	A	U	D	SD
57.	My father thinks I could be good in math.	SA	A	U	D	SD
58.	My math teachers would encourage me to take all the math I can.	SA	A	U	D	SD
59.	I study mathematics because I know how useful it is.	SA	A	U	D	SD
60.	My teachers think I'm the kind of person who could do well in mathematics.	SA	A	U	D	SD
61.	I'm not the type to do well in math.	SA	A	U	D	SD
62.	I don't think I could do advanced mathematics.	SA	A	U	D	SD
63.	Mathematics is enjoyable and stimulating to me.	SA	A	U	D	SD
64.	My mother hates to do math.	SA	A	U	D	SD
65.	I'll need mathematics for my future work.	SA	A	U	D	SD
66.	People would think I was some kind of a grind if I got A's in math.	SA	A	U	D	SD
67.	Being first in a mathematics competition would make me pleased.	SA	A	U	D	SD

ID NUMBER ____________________

Remember: Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

68. My mother thinks I'll need mathematics for what I want to do after I graduate from high school. SA A U D SD

69. My teachers think advanced math is a waste of time for me. SA A U D SD

70. Studying mathematics is just as appropriate for women as for men. SA A U D SD

71. My father thinks I'm the kind of person who could do well in mathematics. SA A U D SD

72. My teachers have encouraged me to study more mathematics. SA A U D SD

73. I am sure I could do advanced work in mathematics. SA A U D SD

74. I would talk to my math teachers about a career which uses math. SA A U D SD

75. Taking mathematics is a waste of time. SA A U D SD

76. My mother thinks I could be good in math. SA A U D SD

77. Knowing mathematics will help me earn a living. SA A U D SD

78. I'd be happy to get top grades in mathematics. SA A U D SD

79. My father has strongly encouraged me to do well in mathematics. SA A U D SD

80. Mathematics is a worthwhile and necessary subject. SA A U D SD

81. My father thinks that mathematics is one of the most important subjects I have studied. SA A U D SD

82. I would rather have someone give me the solution to a difficult math problem than to have to work it out for myself. SA A U D SD

83. My mother thinks I'm the kind of person who could do well in mathematics. SA A U D SD

84. Mathematics will not be important to me in my life's work. SA A U D SD

ID NUMBER ____________________

Remember: Circle the letters that correspond to your answer:

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree

85. I like math puzzles. SA A U D SD

86. My teachers would think I wasn't serious if I told them I was interested in a career in science and mathematics. SA A U D SD

87. My mother thinks I need to know just a minimum amount of math. SA A U D SD

88. I'm not good in math. SA A U D SD

89. My father wouldn't encourage me to plan a career which involves math. SA A U D SD

90. Mathematics is for men; arithmetic is for women. SA A U D SD

91. As long as I have passed, my mother hasn't cared how I have done in math. SA A U D SD

92. I'd be proud to be the outstanding student in math. SA A U D SD

93. My mother thinks advanced math is a waste of time for me. SA A U D SD

94. Getting a mathematics teacher to take me seriously has usually been a problem. SA A U D SD

95. My mother wouldn't encourage me to plan a career which involves math. SA A U D SD

96. Males are not naturally better than females in mathematics. SA A U D SD

Fennema-Sherman Mathematics Attitude Scale: Reliability

The internal consistency estimates of reliability (coefficient alpha) for each scale for both sexes were high, as shown in Table C. They are perhaps somewhat spuriously high due to the negatively skewed distribution of the scale scores.

Insert Table C

On one scale, Math as a Male Domain, the reliability estimates are rather low for Talent Search girls and girls at the all-girl school. A look at the discrimination index for each item reveals for the Talent Search girls, as shown in Table D , low discrimination for items 5, 6, 7, 9, and 10. Thus, girls who, overall, have a fairly low scale score are agreeing with the statements:"Males are not naturally better at mathematics than females " (item 5), and "Women are certainly logical enough to do well in mathematics" (item 6). They are also not agreeing with statements such as "It's hard to believe a female could be a genious in mathematics" (item 7), "I would have more faith in the answer for a math problem solved by a man than a woman" (item 9), and "Girls who enjoy studying mathematics are a bit peculiar" (item 10).

Insert Table D

These same items have much higher discriminating power for boys in the Talent Search, as shown in Table IV:12. Thus, boys who stereotype mathematics as a male domain are more likely to respond in such a way to all such items, whereas girls tend to be more inconsistent in their endorsement of all such negative stereotypic statements.

Table C: Reliability Estimates for Each Scale of the F-S MAS for Each Group, by Sex

	Talent Search			Accelerated Class			All-Girls School			
	Girls	Boys	Total	Girls	Boys	Total	Gr.7	Gr.9	Gr.11	Total
Confidence	.83	.78	.81	.92	.85	.85	.86	.88	.87	.86
Mother	.83	.78	.80	.84	.71	.71	.79	.81	.84	.80
Father	.82	.77	.79	.79	.80	.78	.77	.82	.86	.82
Success	.77	.78	.77	.97	.75	.78	.69	.76	.73	.71
Teacher	.83	.83	.83	.85	.77	.76	.75	.82	.79	.78
Male Domain	.68	.81	.81	.92	.83	.86	.73	.68	.62	.69
Usefulness	.78	.78	.78	.98	.79	.82	.82	.82	.84	.82
Effectance Motivation	.85	.80	.83	.96	.84	.84	.86	.86	.86	.84

Table D: Discrimination Indices for Items on the Math as a Male Domain Scale for Girls and Boys in the Talent Search

Item	Girls	Boys
1. Females are as good as males in geometry.	.44	.63
2. Studying mathematics is just as appropriate for women as for men.	.54	.68
3. I would trust a woman just as much as I would trust a man to figure out important calculations.	.60	.78
4. Girls can do just as well as boys in mathematics.	.61	.76
5. Males are not naturally better than females in mathematics.	.35	.43
6. Women certainly are logical enough to do well in mathematics.	.32	.63
7. It's hard to believe a female could be a genius in mathematics.	.25	.51
8. When a woman has to solve a math problem, it is feminine to ask a man for help.	.40	.41
9. I would have more faith in the answer for a math problem solved by a man than a woman.	.28	.60
10. Girls who enjoy studying math are a bit peculiar.	.11	.55
11. Mathematics is for men; arithmetic is for women.	.47	.68
12. I would expect a woman mathematician to be a masculine type of person.	.45	.48

Although the data can be interpreted as evidence of the weakness of the scale, it is also evidence of the confusion among adolescent girls as to whether or not mathematics is, indeed, a male domain. A girl may believe girls are as logical and mathematically able as boys, but still think it is feminine to ask boys for help with a mathematics problem, or that studying mathematics is more appropriate for men than for women. This suggests that the scale would be improved by having more subtle items, such as the latter examples, and fewer blatantly sexist statements, such as "Women are less logical than men".